DOCUMENT RESUME

ED 045 099 LI 002 230

TITLE	Subject Analysis for Document Finding System; Quantification and Librametric Studies; Management of Translation Service (7th Annaul Seminar, Indian Statistical Institute).
INSTITUTION	Documentation Research and Training Centre, Bangalore (India).
PUB DATE	69
NOTE	638p.: Volume 1: Papers
AVAILABLE FROM	Documentation Research and Training Centre, 112 Cross Road 11, Malleswaram, Bangalore 3, India ($4.50)
EDRS PRICE	EDRS Price MF-$2.50 HC Not Available from EDRS.
DESCRIPTORS	*Classification, *Content Analysis, *Documentation, Information Services, Institutes (Training Programs), *Library Education, *Library Science, Seminars, Subject Index Terms
IDENTIFIERS	*India

ABSTRACT

Thirty-two papers presented at the seventh annual seminar of the Documentation Research and Training Center explore: (1) Universe of Subjects - Its Development and Structure, (2) Subject Analysis and Classification, (3) Subject Headings, (4) Librametry and Its Scope, (5) Subject Analysis, (6) Library Work, (7) Documentation List, (8) Library Usage, (9) Organization of Research, (10) Management of Translation Service and (11) Document Research and Training Center Research Cell: Report for 1969. (MF)

ED045099

OCT 27 1970

③ **DOCUMENTATION RESEARCH AND TRAINING CENTRE**, Bangalore (India)

(INDIAN STATISTICAL INTITUTE)

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D R & T C

7th ANNUAL SEMINAR. Vol. I Papers:

7

①x

SUBJECT ANALYSIS FOR DOCUMENT FINDING SYSTEMS; QUANTIFICATION AND LIBRAMETRIC STUDIES; MANAGEMENT OF TRANSLATION SERVICE;

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V 1 : PAPERS

LI 002230

112 CROSS ROAD 11, MALLESWARAM
BANGALORE 3
⑥ 1969

DOCUMENTATION RESEARCH AND TRAINING CENTRE (=DRTC)

112 Cross Road 11, Malleswaram, Bangalore 3

1 OBJECTIVES

The Documentation Research and Training Centre, established in 1962 by the Indian Statistical Institute, has the following objectives :

1 To do and to promote continuing research in documentation ;

2 To give a course of training in documentation ; and

3 To do consultant service in documentation.

2 THE COURSE

The course offers comprehensive instruction in the theory and practice of documentation. It places emphasis on imparting theoretical knowledge of a high order and at the same time on equipping the student with the necessary professional competence based on practical experience. Instruction is largely individual. Tutorials, small group discussions, and weekly colloquia are organised so as to develop in the students the capacity for systematic thinking and for clear exposition.

In the observational study period, the trainees are given an opportunity to visit and observe the working of specialist libraries, industrial units, and research laboratories. They are also given practical working knowledge of document finding with mechanical aids such as Punched Cards and Computer. They also receive instruction and experience in the organisation and managerial aspects of reprography and translation work.

21 ANNUAL SEMINAR

The Annual Seminar, turned on some specific area of documentation, forms an integral part of the course.

22 HOSTEL

To make this participative work possible, the DRTC is made a residential institution. Living in the hostel attached to it is obligatory.

3 SUBJECTS OF STUDY

Group 1

1 Universe of subjects : its development and structure ;
2 Depth classification *(Theory)* ;
3 Depth classification *(Practice)* ;
4 Library catalogue.

Group 2

5 Documentation ;
6 Management of specialist library
7 *(i)* Mechanised document finding systems ;
  (ii) Elements of statistical analysis ;
8 A project in documentation.

Group 3

9 A project consisting of the survey of the trend in current research in a specific subject.
10 Observational study.

31 PROJECT 1

The project in documentation, to be completed during the formal course in DRTC, consists of the preparation of a documentation list by each student on a specific subject. The work involves scanning and selecting articles from an approved set of periodicals relevant to the subject, minutely classifying the documents, preparation of abstracts of the documents, and preparation of the necessary added entries.

A Depth Schedule for the classification of the subjects covered by the documentation list is also to be worked out simultaneously for the minute classification of the documents.

Continued on page 3 of the cover

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DOCUMENTATION RESEARCH AND TRAINING CENTRE

ANNUAL SEMINAR (7) (1969)

SUBJECT ANALYSIS FOR DOCUMENT FINDING SYSTEMS
QUANTIFICATION AND LIBRAMETRIC STUDIES
MANAGEMENT OF TRANSLATION SERVICE

DRTC Annual Seminar, Papers and Proceedings

(1) (1963) Documentation Periodicals : Coverage.Arrangement.Scatter. Seepage.Compilation.

(2) (1964) Document Retrieval : Classification. Subject Heading. Presentation of Information.

*(3) (1965) Depth Classification. Subject Heading.

*(4) (1966) Universe of Knowledge : Its Structure and Development. Developments in the Design of Depth Schedules. Promotion of the Use of Documentation List in Libraries.

(5) (1967) Developments in Classification. Management of Reprography Service. Subject Headings and Feature Headings.

(6) (1968) Theory and Practice of Abstracting. Developments in Classification. Technique of Teaching Documentation.

* Out of Stock

" The Five Laws of Library Science

1 Books are for use.
2 Every reader his book.
3 Every book its reader.
4 Save the time of the reader.
5 A library is a growing organism."

S R RANGANATHAN

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DRTC Seminar (7)(1969). Paper AA.

SUBJECT SPECIALISTS' VIEW OF THE UNIVERSE OF SUBJECTS: SOME EXAMPLES.

F J DEVADASON, DRTC Trainee, 1969-70.

Understanding the view of subject specialists in regard to the development and structure of the Universe of Subjects would be helpful to the librarian in designing an efficient document finding system for the use of specialists. Since the universe of subjects is ever growing, several attributes of the structure, growth, and function of a living organism are found in the former. This is illustrated in the words of a biologist. Growth demands control. The biological phenomena of fragmentation, hybridisation, and integration of fragments have analogies in the development of the universe of subjects. Examples of emerging "inter-disciplinary" subjects as envisaged by subject specialists are given.

0 DESIGNING A DOCUMENT FINDING SYSTEM

01 Two Universes for Consideration

In the design of a document finding system, the attributes of two universes have to be taken into consideration. These are:

1 Universe of Subjects; and

2 Universe of Readers.

The use of a document finding system has generally to begin with a trilogue between the universe of subjects, the universe of readers, and the document finding system.

02 Recognising the Specialist's View

While examining the Universe of Subjects, the librarian selects its attributes likely to affect the design of the document finding system. These attributes will be related to the structure and development of the Universe of Subjects. If the trilogue mentioned above is to be so conducted as to increase the efficiency of the service of the system, then it would be helpful if the librarian recognises the different ways in which the subject specialists themselves view the development and structure of the Universe of Subjects and contributes to the formation of the different structures and modes of its development.

03 Scope of the Paper

In this paper, some examples of the way in which subject specialists view the development and structure of their respective subject-fields or the Universe of Subjects as a whole, are presented. The formation of "inter-disciplinary subjects" as viewed by subject specialists is also briefly discussed.

1 DEVELOPMENT OF THE UNIVERSE OF SUBJECTS

11 Postulate of Library Science

Law 5 of Library Science states: "Library is a growing organism" (14). The growth of the library is an implication of the growth of the Universe of Subjects embodied in documents. Some aspects of the comparison of the Universe of Subjects to a living organism and the helpfulness of the analogy have been pointed out in an earlier paper (10).

12 View of a Biologist

Paul Weiss, a biologist, compares the growth process of the universe of subjects with that of a living organism in his paper "Knowledge: A growth process" (18). In Table 1, Sec 121, column (b) gives the steps by which a living organism grows, and column (c) gives the corresponding stages in the growth process of the universe of subjects. The terminology used by Weiss has been modified wherever found helpful.

121 Table 1. Comparison of Steps in Growth Process

SN	Steps in the Growth Process	
	Organism	Universe of Subjects
a	b	c
1	INTAKE	
	Raw materials are gathered from the environment and are either stored or passed on directly for alimentary processing.	Raw data gathered from the environment through observation and experimentation are either stored as records or analysed forthwith.
2	DIGESTION	
	Digestible items are chemically broken down, which are then screened and sorted. The wastes and undigestible residues are eliminated.	The products of analysis are screened and sorted according to relevance. The relevant ideas are classified and arranged helpfully for use and further processing. Irrelevant ideas are discarded.
3	ASSIMILATION	
	The true nutrients are circulated to the tissues, whose cells pick what they need, then re-	The ideas in various stages of evolution are widely circulated, leading to confluence

SN	Steps in the Growth Process	
	Organism	Universe of Subjects
a	b	c
	combine and modify it to form intermediary products, some to be recirculated for use by other cells, some still to be discharged as waste, and culminating the synthesis, each cell constructs from this supply pool selectively the substances and structures uniquely characteristic of its own kind.	and critical correlation with a large number of contributions from other sources. From this, some empirical guiding principles may arise. These are tested and verified and integrated with the body of knowledge.
4	UTILISATION In this last step, cells branch in two directions: they either turn to the manufacture of special products or reproduce, that is, add more cells to the body.	A part of the addition to a subject is converted into differentiated products commonly lumped under "applied", while another part accrues to its own body, perhaps forming a theory of its own.
5	CYCLE REPEATS	CYCLE REPEATS

13 Illustration of Growth Process

Figure 1 illustrates the growth process in an organism and in the universe of subjects. The information in the upper half of each rectangle relates to the growth process of the universe of subjects and the lower to that of an organism. This is a modified version of the diagram used by Weiss.

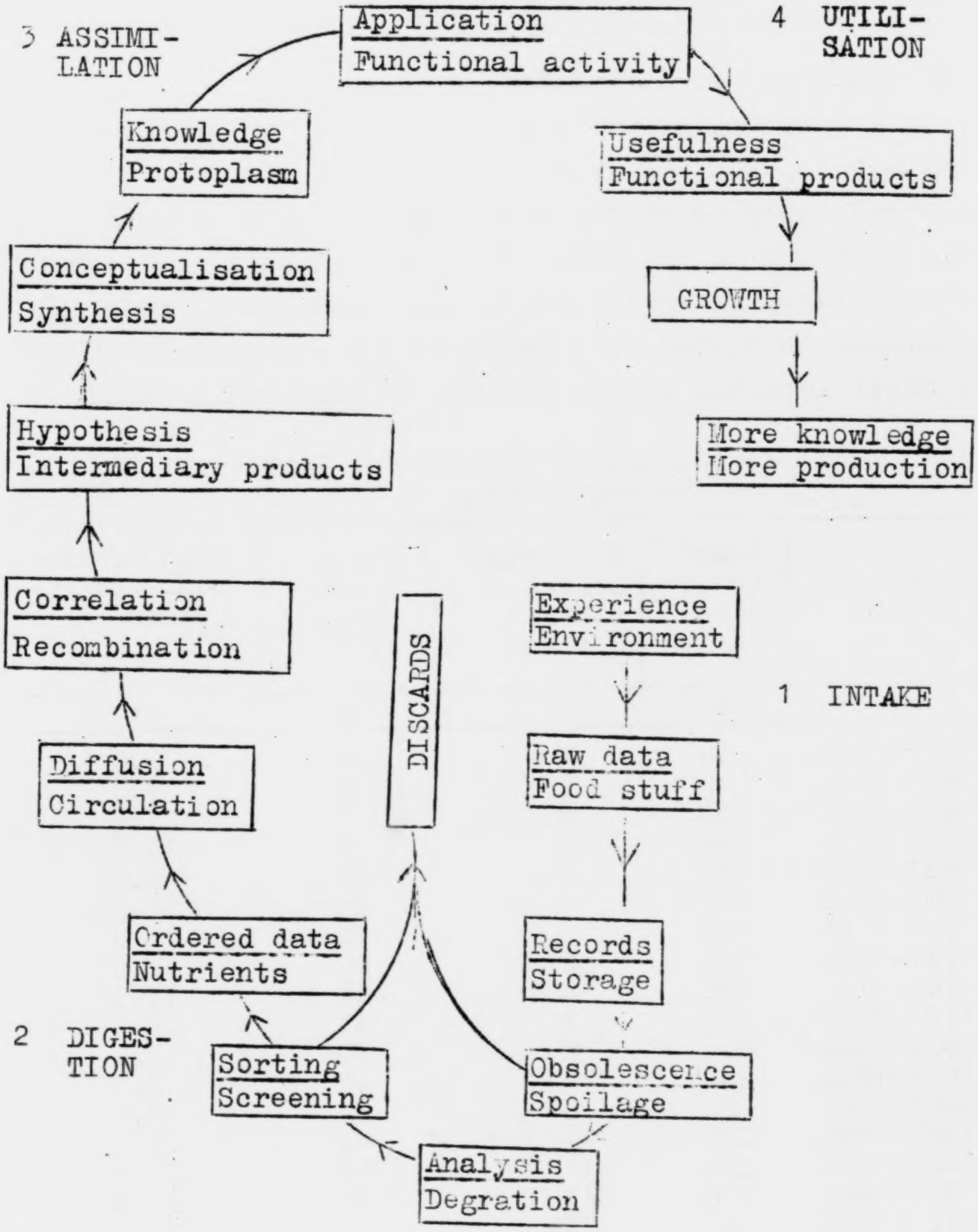
3 ASSIMI-LATION
Application
Functional activity
4 UTILI-SATION
Knowledge
Protoplasm
Usefulness
Functional products
Conceptualisation
Synthesis
GROWTH
Hypothesis
Intermediary products
More knowledge
More production
Correlation
Recombination
DISCARDS
Experience
Environment
1 INTAKE
Diffusion
Circulation
Raw data
Food stuff
Ordered data
Nutrients
Records
Storage
2 DIGES-TION
Sorting
Screening
Obsolescence
Spoilage
Analysis
Degration

Fig 1. Growth Process

14 Annotation

1 The analogy between the growth process of the universe of subjects and that of an organism holds good in a large measure.

2 Weiss adds, "Our growth analogy could be expanded -- tradition, standing for heredity; novel ideas, for mutation; and the team approach, for symbiosis."

15 Logistic Growth Pattern

The normal growth pattern of a living organism closely follows a logistic curve (16). Price has given several examples of the logistic pattern of growth in the universe of subjects (13). An analysis of the data collected by me on the number of significant ideas contributed to Engineering leads to the recognition of a similar logistic growth pattern in engineering also.

151 Table 2. Census of Significant Contributions to Engineering

Range in Years	Cumulative total of (a)	N of Significant contributions	Cumulative total of (c)	Rate of annual contribution X 100
a	b	c	d	e
1600-1620	20	2	2	10.0
1621-1640	40	1	3	7.5
1641-1660	60	4	7	11.6
1661-1680	80	4	11	13.7
1681-1700	100	2	13	13.0
1701-1720	120	3	16	13.3
1721-1740	140	2	18	12.8
1741-1760	160	2	20	12.5
1761-1780	180	4	24	13.3
1781-1800	200	7	31	15.5
1801-1820	220	2	33	15.0
1821-1840	240	12	45	18.7
1841-1860	260	8	53	18.9
1861-1880	280	11	64	22.8
1881-1900	300	11	75	25.0
1901-1920	320	14	89	27.8
1921-1940	340	32	121	35.5
1941-1960	360	26	147	40.8

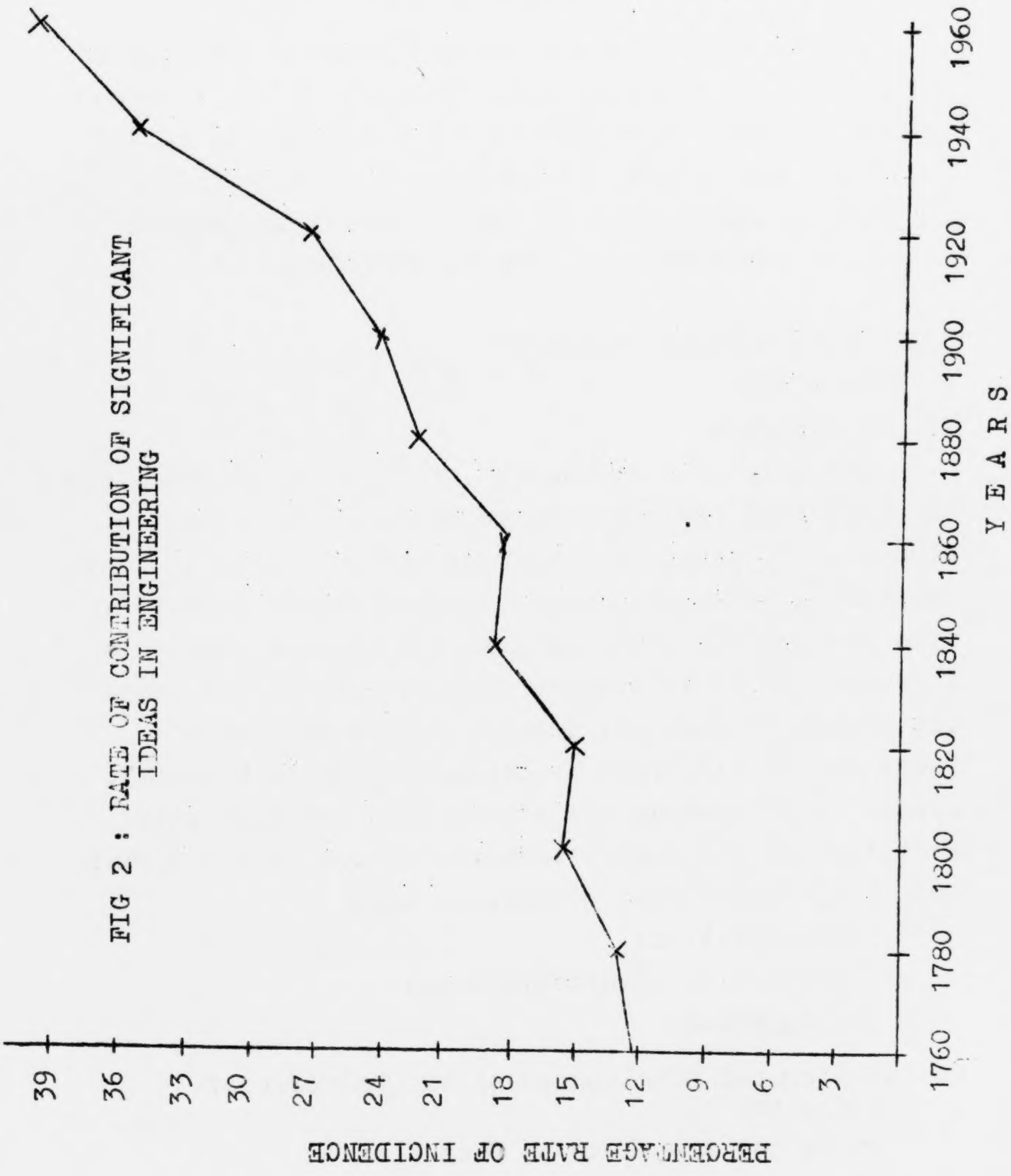

FIG 2 : RATE OF CONTRIBUTION OF SIGNIFICANT IDEAS IN ENGINEERING

16 Annotation

1 A number of logistic curves for different periods could be seen in the graph. Example: for the periods 1640-1700; 1780-1820; 1860-1920.

2 The bottom of the troughs tends to straighten out as we come towards recent years. If the trough-period is taken to relate to the assimilation period following the intake of significant contributions, the pattern indicates that in recent years, the assimilation of new ideas has been accelerating.

2/4 DRIVE TOWARDS STABILITY

2 HOMEOSTASIS

21 In Organism

The idea of Homeostasis originating in the field of physiology has now been generalised to cover the behaviour of non-living systems also. Stated in general terms, "When any dynamic system drives forward in time so that its state changes but not the laws that it obeys, it tends towards some sub-set of the possible states -- that is, towards some equilibrium". There may be different mechanisms by which a dynamic system tends towards the states that are partially resistant to the change-inducing action of the dynamic laws (7). Three such mechanisms are:

1 Fragmentation;
2 Combination (Synthesis); and
3 Integration.

22 Accelerated Development of the Universe of Subjects

It is now a well-known fact that:

1 During the last few decades, social pressure in

the form of population pressure has been increasing in many countries;

2 There has been a shortfall in the commodities and services required to meet even the basic needs of the growing population; consequently,

3 There has been increasing emphasis on the accelerated production and distribution of consumable commodities and services, utilising all kinds of resources to wipe off the shortfall mentioned in 2; This has called for

4 Increased provision for a fuller utilisation of human resources, particularly the intellectual resources -- the thought resources of science and technology; and as a result,

5 There has been an acceleration in the downpour of ideas of different kinds -- seminal, near-seminal, pedestrian, etc.

23 Restoration of Equilibrium: Fragmentation

The factors mentioned in the preceding section tend to make the universe of subjects bigger and more dynamic than ever before. This is in conformity with the principle that the rate of growth of an entity is proportional to its size -- the bigger it is, the faster it grows. One of the ways in which this growth has been counteracted is through the fragmentation of the universe of subjects. One evidence is the large number of specialisations on small chunks of the Universe of Subjects attracting small groups of specialists. This process has been going on for a few centuries now. It is a convenient way of dealing with the Universe of Subjects, each group of specialists sharing the cultivation of some fragment or other (11).

24 A Specialist's View of the Effect of Specialisation

The continuous fragmentation of the Universe of Subjects and specialisation in very small fragments of it have, however, outrun contact, and communication between disciplines is becoming increasingly difficult. One reason for this isolation between the disciplines is that in the course of specialisation, the receptors of information themselves become specialised. Boulding comments, "One wonders sometimes if science will not grind to a stop in an assemblage of walled-in-hermits, each mumbling to himself words in a private language that only he can understand" (2). Such extreme state of specialisation necessitated by the accelerated growth of the Universe of Subjects is counteracted by an automatic process of slowing down of the growth of the Universe of Subjects. This is because the isolated piece of information obtained by a group of specialists in a narrow field has in itself no value but only in its assimilation with the rest of knowledge and only in as much as it really contributes to the synthesis (15).

25 Combination

Another mechanism by which equilibrium in the Universe of Subjects is achieved is through combination -- hybridisation and synthesis of the fragments.

3/7 COMBINATION

3 TEAM RESEARCH

In Sec 22(4), it has been mentioned that there has been increasing emphasis on the better utilisation of the thought-resources of science and technology. This has necessitated a replacement, in a large measure, of solo-research by team-research and research-in-parallel by research-in-series. The change from "little science" to "big science" has either resulted in, or has been made possible by team-research. Several reasons have been given to explain the shift (12). We need to note here that specialists in different subject-fields are brought into the team to work together and coordinate their activities in a way conducive to the achievement of the objectives of the project being worked upon. This has in some measure led to a coming-together of different disciplines. As a result, the slowing down process resulting from fragmentation is to some extent overcome.

4 INTER-DISCIPLINARY ACTIVITY

41 Hybrid Discipline

The first symptoms of inter-disciplinary activities are the so-called "hybrid disciplines".

42 Two-Parented Hybrid

Kenneth Boulding in his paper "General Systems Theory: The Skeleton of Science" (1) has mentioned a few two-parented hybrid disciplines. The first to emerge as a two-parented hybrid was Physical Chemistry in the late nineteenth century. Then came Social Psychology in the second quarter of the twentieth century. In the physical and biological sciences, the well-established hybrid sciences are Astrophysics, Biophysics, and Biochemistry. In the Social Sciences, Social Anthropology is also fairly well-established. Two-parented hybrids just emerging are Economic-Psychology and Economic-Sociology. Boulding considers that there are signs for Political Economy to have a rebirth.

43 Multi-Parented Hybrid

Boulding places under the category of Multi-parented hybrids, inter-disciplinary subjects that have a much more varied and at times even obscure ancestry than the two-parented hybrids. These result from a selection, reorganisation, and synthesis of ideas from several areas of knowledge. Examples given are:

1 Cybernetics -- the science of control and communication in all of its various manifestations in machines, animals, and organisations. It incorporates and unifies the work of the servo-mechanisms and systems engineering, the communication engineering and certain aspects of the work of the physiologist, neurologist, psychologist, economist, and sociologist (9);

2 Organisation theory, which has emerged out of Economics, Sociology, Engineering, and Physiology; and

3 Management science.

44 "Inter-Departmental" Inter-Disciplines

The inter-departmental inter-disciplines develop through the establishment and activities of inter-departmental institutes, such as the Institute of Industrial Relation, of Public Administration, and of International Affair (3).

45 Multi-Hybrids with Common Methodology

Multi-hybrid disciplines organised around the application of a common methodology to many different fields and problems include Survey Research and Group Dynamics.

46 Multi-Hybrid Discipline: Theory of Individual Behaviour

Each discipline studies some kind of "individual" -- electron, atom, molecule, crystal, virus, cell, plant, animal, man, family, tribe, state, firm, university, etc. Each of these individuals exhibits 'behaviour', action or change and this behaviour is considered to be related in some way to the environment of the individual -- that is, with other individuals with which it comes into contact. Each individual is regarded as consisting of a structure of complex of individuals of the order immediately below it. The behaviour of each individual may be explained by the structure and the arrangement of the lower individuals of which it is composed, or by certain principles of equilibrium or homeostasis (See Sec 2) according to which certain 'states' of the individuals are "preferred". Behaviour is described in terms of the restoration of this preferred state when they are disturbed by the changes in the environment (4).

47 Multi-Hybrid Discipline : General Theory of Growth

There is hardly any discipline in which the growth-phenomenon does not have some importance. Although there is a great difference in complexity between the growth of crystals, embryos, societies, several of the principles and concepts that are important at the lower levels are applicable at the higher levels also. In other words, all growth phenomena are sufficiently alike and this may possibly be a newly emerging discipline (4).

5 BORDER SCIENCE

Solco W Tromp, a noted bioclimatologist, in his essay Significance of border sciences for the future of mankind has discussed examples of established as well as newly emerging Border Sciences as he has named them (17).

51 Definition

A Border Science comprises those branches of science which interconnect the fringes of well-established basic sciences (either formal sciences such as mathematics; natural sciences such as physics and chemistry; biosciences such as biology and medicine; or mental sciences such as psychology, sociology, etc) forming a new independent discipline. "It may also comprise of fundamental research which penetrates into completely unknown realms of human knowledge until recently considered the domain of vague, unrealistic, quasi-scientists and unfortunately often the hunting ground of scientific charlatans."

52 Enumeration of Border Sciences

Tromp has enumerated the following Border Sciences:

1 Established Border Sciences:
  A Geological Sciences
  B Psycho-physics
    1 Physical embryology
    2 Physical neurology
    3 Geo-ecology
    4 Biorhythmics
  C Cybernetics
2 Non-Established Border Sciences:
  A Astronautics
  B Supersensorics

In Sec 6 and 7, the scope of each of the Border Sciences, excepting Geological Sciences, is briefly given.

6/7 SCOPE OF BORDER SCIENCES

6 ESTABLISHED BORDER SCIENCES

61 Psycho-Physics

Psycho-physics consists of a group of Border Sciences which study the fundamental psycho-chemical properties of the "web of life" and its inter-relationships with the inorganic and organic world surrounding it. It comprises of several divisions such as Physical Embryology, Physical Neurology, Geo-ecology and Biorhythmics.

611 Physical Embryology

Physical Embryology is the study of the physico-chemical, particularly the physical aspects of the fundamental problems of life in its embryonic stages.

612 Physical Neurology

Physical Neurology is the study of the physical mechanism of nerve condition and brain process in general.

613 Geo-ecology

Geo-ecology is the study of the inter-action between environment and living organism which includes the conditions of life, behaviour, etc. It comprises of the following three sub-disciplines:

1 General Geo-ecology.- General Geo-ecology deals with the conditions of life, behaviour and geographical distribution of plants, animals, and man.

2 Medical Geography.- Medical Geography deals with geographical distribution of diseases.

3 Geographical Pathology.- Geographical Pathology deals with the differences in clinical symptoms, severity and development of diseases in different parts of the world.

4 Bio-Climatology and Bio-Meteorology.- The International Society of Bioclimatology and Biometeorology has defined the field as "the study of the direct and indirect inter-relations between the geophysical and geochemical environment of the atmosphere and living organisms ... the term 'Environment' being broadly conceived and including micro, macro, and cosmic environments and the diverse physical and chemical factors comprising these environments."

Examples of the divisions of Bioclimatology are given as follows:

- BIOCLIMATOLOGY
  - Phytological
    - Bioclimatological phenology
    - Ecological climatography
  - Zoological
    - Entomological
    - Veterinary
  - Human
    - Physiological
    - Aestheto
    - Psychological
    - Archaeological
    - Social
      - Urban
    - Cosmic
  - Palaeo-bioclimatology

614 Biorhythmics

Biorhythmics is the study of the existence of certain fundamental rhythmical phenomena of the living processes in plants, animals, and man.

62 Cybernetics

Cybernetics is the study of the direction and control of certain distance mechanism in the inorganic and living world. It comprises the "Control and communication theories", "Feed-back mechanisms" and the processes involved in "Memory" both in the mechanical and living world. (See also Sec 43(1)).

7 NEWLY EMERGING BORDER SCIENCES

Tromp conjectures that the so called non-established Border Sciences may develop into new independent Border Sciences or as branches of existing Border Sciences in a not too distant future.

71 Astronautics

Astronautics deals with the problems involved in the transport of both the living and non-living things from earth's crust into the outer space and with the conditions under which living organisms could live in outer space.

72 Supersensorics

Supersensorics (known also as extra-sensorics) is concerned with the study of certain phenomena shown by living organisms, the registration of which seems to take place by means of physiological or other mechanisms unknown at present in human physiology.

Examples of divisions of Supersensorics are given as follows:

- In man
  - Paragnostic phenomenon
    - Telepathy
    - Clairvoyance
  - Stigmatisation phenomenon
  - Hypnosis
  - Trance condition
  - Yogic phenomenon
- In animal
  - Direction finding
  - Homing instinct

73 Team Research Necessary

Extremely complex branches of human knowledge can be developed as Border Sciences only by a great many experts in various disciplines working together in a true team spirit (17).

8 INTEGRATIVE DISCIPLINES: SPECIALIST'S VIEW

Another mechanism by which equilibrium in the Universe of Subjects is achieved is through the development of Integrative Disciplines. The search for integrated concepts has been going on through all the ages since man learned to use words (6).

81 General Systems Theory

Boulding has viewed "General Systems Theory" as an integrative discipline unifying many subjects in the Universe of Subjects. General Systems Theory discusses the general relationship in the empirical world and describes a level of theoretical model-building, lying somewhere between the highly generalised constructions of Pure Mathematics and the specific theories of the specialised disciplines. One of the main objectives of the General Systems Theory is to develop a framework or structure of systems with the aid of which the structure of particular disciplines can be related in a helpful sequence of coherent corpus of knowledge to enable a specialist in one field to catch relevant communications from others (1).

82 Two Approaches

Boulding has suggested two possible approaches to the General Systems Theory (1):

1 To look over the empirical field of human experience and to pick out certain general phenomena common to many different disciplines, and to seek to build up general theoretical models relevant to these phenomena; and

2 To arrange the empirical field of human experience in a hierarchy of complexity of organisation of their basic "individual or unit of behaviour" and develop levels of abstractions appropriate to each.

83 Examples of the Method of Approach

831 For the First Approach

1 Models of population change and interaction dealing with ecological systems in biology, capital theory in economics, and certain problems of statistical mechanics.

2 A general theory of the "behaviour" of an individual based on the structure, arrangement, and function of the lower individuals of which it is composed, or by certain principles of equilibrium or homeostasis.

3 A general theory of growth (5).

4 A general theory of information and communication.

By this approach, Boulding conjectures that ultimately a general field theory of the dynamics of action and interaction may result. (See also Sec 832(2)).

832 For the Second Approach

1 The theory of integrative levels as introduced by the biochemist Needham in the 1930's, by Novikoff in 1945, by Feibleman in 1954 (8) and by Boulding (1).

2 New cross-disciplinary specialisation.- In Boulding's two works, The image and the Meaning of the twentieth century (19), a cross-disciplinary synthesis is propounded. The resulting discipline is named "Eiconics".

By using Eiconics, Boulding attempts to give an insight into economics, politics, science, history, ideology, and the population and the war traps. He has used it for the analysis of large critical social issues. He writes, "It is possible to create organised feedbacks within the general framework of the scientific sub-culture which will alter the 'public image' or images of this sub-culture in useful, creative and organically growing ways".

Boulding's Eiconics includes time-binding, signal-symbol differentiation, delayed reaction, science as a basic orientation, and to-me-ness. He uses seven levels of organisations: Statics, mechanics, homeostasis, the living cell, plant, animal and human being (19).

91 CONCLUSION

A knowledge of the modes of development of the Universe of Subjects as seen by the subject specialists is of help in the design and development of schemes for classification. It would, for example, be useful to examine the modes of formation of inter-disciplinary subjects, Border Sciences, etc, in relation to the different modes of formation of subjects already recognised in the General Theory of Classification. Further, it may also be examined whether the different Border Sciences should be brought together in one place in the scheme for classification or would it be more helpful to disperse them in the scheme according to the affinity of each to other subjects. It is interesting to note that the modes of formation of different subjects and the modes of development in the Universe of Subjects are derivable from the analogy of the Library being considered a living organism (Law 5 of Library Science).

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PUBLIC HEALTH: DEVELOPMENT AND STRUCTURE.

R AHUJA, Mahatma Gandhi Memorial Medical College Library, Jamshedpur, and DRTC Trainee, 1969-70.

The stages of development and the dominant characteristics of the different subjects falling in the field of Public Health are mentioned. The characteristics of the subjects Clinical medicine, Preventive medicine, and Social medicine in relation to Public Health are indicated. Examples of different kinds of Specials Basic Subjects with Public Health as Host Main Subject are given. The scope of subjects such as Medical Sociology, Human Ecology, Social Anthropology, Social Psychology, Social Paediatrics, Social Geriatrics, and Social Pathology that contribute ideas to Public Health studies, is briefly outlined.

0 SCOPE OF THE PAPER

In CC (Colon Classification) upto and including its edition 6, amended (1963), Public Health was taken to form a Compound Subject with Medicine as its Basic Subject. In edition 7 (1971), Public Health has been made a Main Subject on a consideration of the literary warrant in the subject and other factors.

This paper gives a brief description of the subject Public Health, with particular reference to

1 The main stages in the development of the subject;

2 The significant contributions to the subject, leading to its wide coverage today;

3 The major topics of interest of the specialist in Public Health;

4 The formation of Specials Basic Subjects with

Public Health as the Host Main Subject; and

5 The penumbral and inter-related subjects.

1 SCOPE OF PUBLIC HEALTH

Something of the vast scope of Public Health as it is understood and practised today may be envisaged from the typical functions of a state public health service. These functions include:

1 Control of communicable and chronic diseases;

2 Operation of clinics for mothers and children;

3 Operation of laboratories and clinics for various preventive and diagnostic services;

4 Provision of public health nursing service;

5 Environmental health service including the inspection, supervision, and sanitary control of water-supply, sewage disposal facilities, milk production and distribution, and food handling establishments;

6 Collection and analysis of vital statistics;

7 Operation of community hospitals, nursing homes, and rehabilitation centres;

8 Community health planning, consultation, and coordination; and

9 Public health education and information dissemination.

2 VARIETY OF SPECIALITIES INTERACT

To provide a public health service of a comprehensive kind mentioned above, it is necessary to bring together for cooperative and coordinated action, specialists in a variety of disciplines. The specialists include physicians, microbiologists, nurses, dentists, sanitarians, engineers, psychologists, educators, sociologists, social workers, together with supporting technical, statistical, and administrative personnel.

3 MAIN STAGES OF DEVELOPMENT

31 Early Ideas

The concept of public health, as it is understood and practised today, developed largely during the last hundred years. However, efforts to control epidemic diseases are known to have been made even in ancient times. For example, a fairly complete picture of isolation and quarantine procedures for dealing with leprosy, and the essentials of community sanitation is given in the books of Leviticus and Deuteronomy. In the Mosaic days, the principles of isolation of infectious cases were known and disinfection of infected materials by burning and regulations for abatement of nuisance were practised. Public water supply, sewage facility, and bathing houses were provided on a large scale during the period of the Roman Empire. Such public health systems are known to have been in operation in ancient India and China also. The excavations in Sarnath and Mohanjadaro have disclosed this. The plague epidemic of the fourteenth century led to the establishment of quarantine stations in the important ports of Europe.

32 Acceleration of Progress

Two important ideas that emerged in the eighteenth century led to an accelerated development of public health. These were:

1 The development of modern scientific ideas and attitudes, suggesting the possibility of control of the forces of nature by man; and

2 The humanitarian movement motivating people to apply such knowledge for public good.

The Germ theory of Louis Pasteur (1854), the isolation of the Tubercule Bacillus (1882) by Robert Koch, and the discovery of the value of vaccination against smallpox by Edward Jenner (1798) marked the beginnings of a series of developments in public health. The five phases of the Public Health movement in the twentieth century in England are mentioned below.

Phase	Starting Period (20th century)	Particulars
1 & 2	First decade	Purification of water supply. Control of disposal of waste. Control of insect carriers of diseases. Scientific isolation and quarantine practice. Immunisation using vaccines and sera.
3 & 4	Second decade	Campaign against tuberculosis: Health education, dissemination of information about personal hygiene, clinics for early diagnosis and prevention of the disease. Control of venereal disease, infant mortality, mental disease, heart disease, and cancer. Public health nursing service.
5	Mid-century	Social and economic factors as they are related to housing, nutrition, medical care and social security.

33 Chart of Stages of Development

The following table gives a summary of the main stages of development of the ideas of Public Health.

Table Summarising the Development of some of the Major Ideas in Public Health

Period	Origin/ Coverage	Discipline	Dominant ideas	Basis for hypothesis	Emphasis	Basis and approach to control	Result
First Century BC	Greek	HYGIENE	Epidemics	Consideration of earth, meteorologic and celestial environment	Control of epidemics	External and remote environment	Supression of witchcraft, etc
Middle ages upto 16th century	Roman and French	SANITATION	Infectious disease control	Co-relation of uncleanliness with disease	Personal hygiene and sanitation	Physical environment helps biological environment	Supression of miasmatic theory
Industrial Revolution 17-18th centuries	Europe	PUBLIC HEALTH	Community health	Vaccination. Asepsis	Control cf infection	State responsibility. Public Health Acts. Epidemiological approach.	Industrial hygiene.

Period	Origin/ Coverage	Discipline	Dominant ideas	Basis for hypothesis	Emphasis	Basis and approach to control	Result
Post-Industrial Revolution, 19th century	Europe and America	PREVENTIVE MEDICINE	Bacteriology. Prevention of infection.	Control of agents of disease. Koch's postulates	Horizontal and vertical levels of prevention. Health check up scheme.	Natural history of disease. Ehrlichs hypothesis. Host resistance. Environmental factors.	International cooperation in health matters.
Modern era. 20th century., First half	International	SOCIAL MEDICINE	Promotion of health Socio-economic factors	Epidemological and environmental factors. Disease carrier.	Total man and total environment. Nature in health and disease.	Bio-social, psychological and socio-economic factors. Social diseases. Environmental and social sanitation.	Positive health. Consideration of totality of factors.

Period	Origin/ Coverage	Discipline	Dominant ideas	Basis for hypothesis	Emphasis	Basis and approach to control	Result
Future. 20th century, Second half onwards	Global	ENVIRONMENTAL MEDICINE	Environment as as a major factor of health	Natural and social environment. Adaptation.	Comprehensive health service. Hospital clinic, home. Social security.	Unpolluted environment. Man's view of the universe from the periphery.	Implementation of positive health concept on a global scale.

Public health specialists have in recent years been much concerned with three major health hazards:

1 Pesticides used in homes, fields, warehouses, etc;

2 Toxic substances; and

3 Radiation, fall-outs from nuclear explosions, etc.

34 Number of Contributions

The following table gives data on the number of significant contributions to different subjects of Public Health interest during the period 1500-1950.

SN	Subjects in Public Health	N of Significant Contributions				
		1500-1700	1700-1850	1851-1900	1901-1950	Total
1	Sanitation, Rural and Urban Health	..	22	15	19	56
2	Bacteriology, Immunology Epidemiology	16	26	72	72	186
3	Maternal and Child Health Service	..	13	1	13	27
4	Occupational Health Service	4	7	2	6	19
5	Mental Health Service	..	11	2	..	13
6	Nursing and Rehabilitation Service	..	3	7	1	11
7	Vital Statistics	..	11	2	1	14
8	Health Administration	..	8	15	4	27
	Total	20	101	116	116	353
	N of Years ..	200	150	50	50	450
	Average N of Contributions per 10-year period	1	7	23	23	8

341 Annotation

1 As in most other fields of science, the rate of significant contributions to Public Health has

increased since 1500 AD, reaching a maximum of 23 per decade in the latter half of the nineteenth century. The same rate has been kept up in the first half of the present century.

2 Out of the 353 contributions over the 450-year period, over 52 per cent has been in the subjects Bacteriology, Immunology and Epidemiology taken together.

3 In these three subjects, more than 77 per cent of the contributions were during the last one century.

4 MAJOR FIELDS OF INTEREST TO SPECIALIST IN PUBLIC HEALTH

The subjects falling in the fields of Clinical Medicine, Preventine Medicine, and Social Medicine, are among the major areas of interest to the specialist in Public Health.

41 Table

The following chart indicates the interrelation between the above-mentioned three fields, considered on the basis of certain characteristics.

Characteristic	Clinical Medicine	Preventive Medicine	Social Medicine
Objective	Prevention; failing, cure; failing, relief of suffering and premature death	Prevention of disease. Rehabilitation. Increase in human efficiency and life expectancy.	Evolved stage of public health dictated by needs of society. Improving human resource.

Characteristic	Clinical Medicine	Preventive Medicine	Social Medicine
Approach	Individual care; higher turnover of patients and discharges at quick rate. Early diagnosis and treatment. Psychology and pathology of disease. Technique oriented.	Promote preventive attitudes. Humanistic. Efficiency and economy in health care. Group health. Quantity and quality. Positive and total health.	Social hygiene to fit social milieu. Environmental and social sanitation. International cooperation. Constructive medicine.
Method	Diagnosis. Local pathology. Specialities. Prognosis. Treatment.	Epidemiology. Bio-statistics. Social pathology. Immunisation. Preventive.	Total man. Total environment. Field epidemiology applied to individual, family, and community.
Emphasis	Mortality more than morbidity.	Morbidity more than mortality	Morbidity and mortality. Total health increases total wealth.
Resource	Hospital. Clinic	Health legislation. Domiciliary service. Health centre. Research laboratory, integrated outpatient department.	Rural and urban field health service. Comprehensive.
Evaluation	Subjective, individual appraisal of doctors. Objective, sickness and suffering.	Reduction of morbidity and mortality rates. Expressed needs of population.	Academic discipline. Individual clinical practice. Instrument of social policy.

42 Specials Basic Subject.

A perusal of the catalogues of publications of WHO indicates the possibility of formation of Specials Basic Subjects of various kinds with Public Health as the Host Main Subject. Division of the Main Subject by the "Environment Characteristic" is one of the ways in which such Specials Basic Subjects are formed. Here are some examples of titles of documents dealing with such subjects:

1 Good health in the tropics.
2 Public health in the Arctic and Antarctic.
3 Hygiene of seafarers.
4 Guide to ship sanitation.
5 Guide to hygiene and sanitation in aviation.
6 Modern trends in occupational health.
7 Health problems in agriculture.
8 Public health problems in rural areas.
9 Maternal and child health in developing countries.
10 Military hygiene.

Division of the Main Subject Public Health by "Age Characteristic" and by "Sex characteristic" are other modes of formation of Specials Basic Subject. Here are some examples dealing with such subjects (WHO catalogue):

1 Child health in developing countries;
2 Public health aspects of low birth weights;
3 Health problems of ageing and aged; and
4 Maternal health in developing countries.

In all the above cases, the formation of Specials Basic Subjects in Public Health is similar to such formations in Medicine. In addition, subjects of the following kinds also have literary warrant even at the book level.

1 Dental health service;
2 Public health nursing;
3 Mental health service; and
4 Combination of any of these with a Specials Basic Subject mentioned earlier.

5 PENUMBRAL SUBJECTS AND TREND

Public Health is a developing subject. It draws from and is affected by the developments in a large number of other fields ranging from Chemistry, Biology, Veterinary Medicine and Medicine among the Natural Sciences at one end, through Psychology among the Humanities, to Education, Economics, International Relations, Sociology and Law among the Social Sciences, at the other. It is not difficult to recognise the close relation of some of the subjects in the field of Natural Sciences, particularly the subjects going with Medicine, with different aspects of Public Health. However, it is noteworthy that the following subjects, mainly from the field of Social Sciences, have, in recent years, come to be emphasised in courses on Public Health. There is a high probability of Public Health being the secondary phase in relation to these subjects.

1 Medical Sociology;
2 Human Ecology;
3 Social Anthropology;
4 Social Psychology;
5 Social Paediatrics;
6 Social Geriatrics; and
7 Social Pathology.

The objectives of each of these subjects in relation to Public Health are briefly mentioned in the succeeding sections.

51 Medical Sociology

Securing maximum benefit of positive health to the largest population in minimum time on the basis of a study of the relation of the individual -- religious, political, economic and cultural -- to the other members of the community.

52 Human Ecology

Understanding the natural history of health and disease and thus promoting preventive approach to disease and restoration of health, on the basis of the study of the environment of the individual, starting from the intimate family environment.

53 Social Anthropology

An understanding of the racial customs and habits of the community very much influences the success or failure of acceptance of new ideas on health by the community.

54 Social Psychology

Rehabilitation of anti-social elements and social misfits through positive mental and social health services on the basis of the study of the behaviour of the individual in the social environment.

55 Social Paediatrics

Use of the findings of studies in sociology, such as on juvenile delinquency, sibling rivalry, and parent-child relationship, could lead to better organisation of child health services and guidance clinics.

56 Social Geriatrics

Increase in life expectancy leads to a higher percentage of aged people needing both respect and protection. Studies on the behaviour and the physical and mental capacities of the aged can lead to a better utilisation of such manpower.

57 Social Pathology

Degeneration of society -- intemperance and physical, mental, moral and spiritual degeneration -- and destitution due to various disasters and social evils, can lead to a variety of social diseases. Control of such diseases needs coordination of clinical, preventive, and social medical services.

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DRTC Seminar (7)(1969). Paper AC.

PSYCHOLOGY: DEVELOPMENT AND STRUCTURE.

M P SINHA, Jadavpur University Library, Calcutta 32, and DRTC Trainee, 1969-70.

The origin, developmental history, the period of empirical and measurement studies the rise of Systems of Thought, and the significant contributions to Psychology, are briefly described. The content of Psychology -- the general framework, the input process, the central process, the output process, the methods and techniques of study and the postulates -- are mentioned. The relation of Psychology and its components to the other subjects is charted. The position of the Main Subject Psychology in the schedule of Main Subjects, and some of its possible new Basic Subjects, are briefly discussed.

1 SCOPE OF THE PAPER

This paper gives a brief description of the subject Psychology, with particular reference to the

1 Major stages in its development;

2 Significant contributions, the development of the Systems of Thought, and the current postulates of the subject;

3 Major ideas constituting the subject and the techniques of study used by the specialists in it;

4 Interrelation of it with the other subjects; and

5 Possible formation of new Basic Subjects with it as the Host Main Subject.

11 Three Fields of Investigation

When 'knowledge' itself is the subject matter of investigation, three broad fields of study may be recognised. These are:-

1 The structure of the subjective process called knowing. This belongs to the field of Psychology;

2 The specific character of the entities of the external world. This belongs to the field of Natural sciences; and

3 The nature of truth, as distinguished from the mind that recognises it and from the facts about which it is. This belongs to the field of the Theory of Knowledge and of Logic.

The discussion in this paper is confined to "Psychology".

2 FIELD OF PSYCHOLOGY

The distinctive field of Psychology is the behaviour of an individual in response to a stimulus. In recent years, such studies have been extended to non-living systems, such as electronic devices. The term 'Behavioural Science' is sometimes used to denote 'Psychology' if the stimulus pertains to a specific environment such as Education, Political conditions, Economics, Sociology, or Legal System.

21 Interaction with other Subjects

In studying the behaviour of an individual -- by himself and in groups -- Psychology impinges upon and borrows from several other disciplines. These range from those in the Physical and the Biological sciences, among the Natural sciences, through the Arts, Philosophy and Religion among the Humanities, to Education, History, Political science, Economics, Sociology and Anthropology among the Social sciences.

22 Chart

The chart in Sec 221 broadly indicates the inter-relation of Psychology and its subdivisions with other disciplines. The upper section of the chart shows the relation between modern Psychology and its most closely related fields.

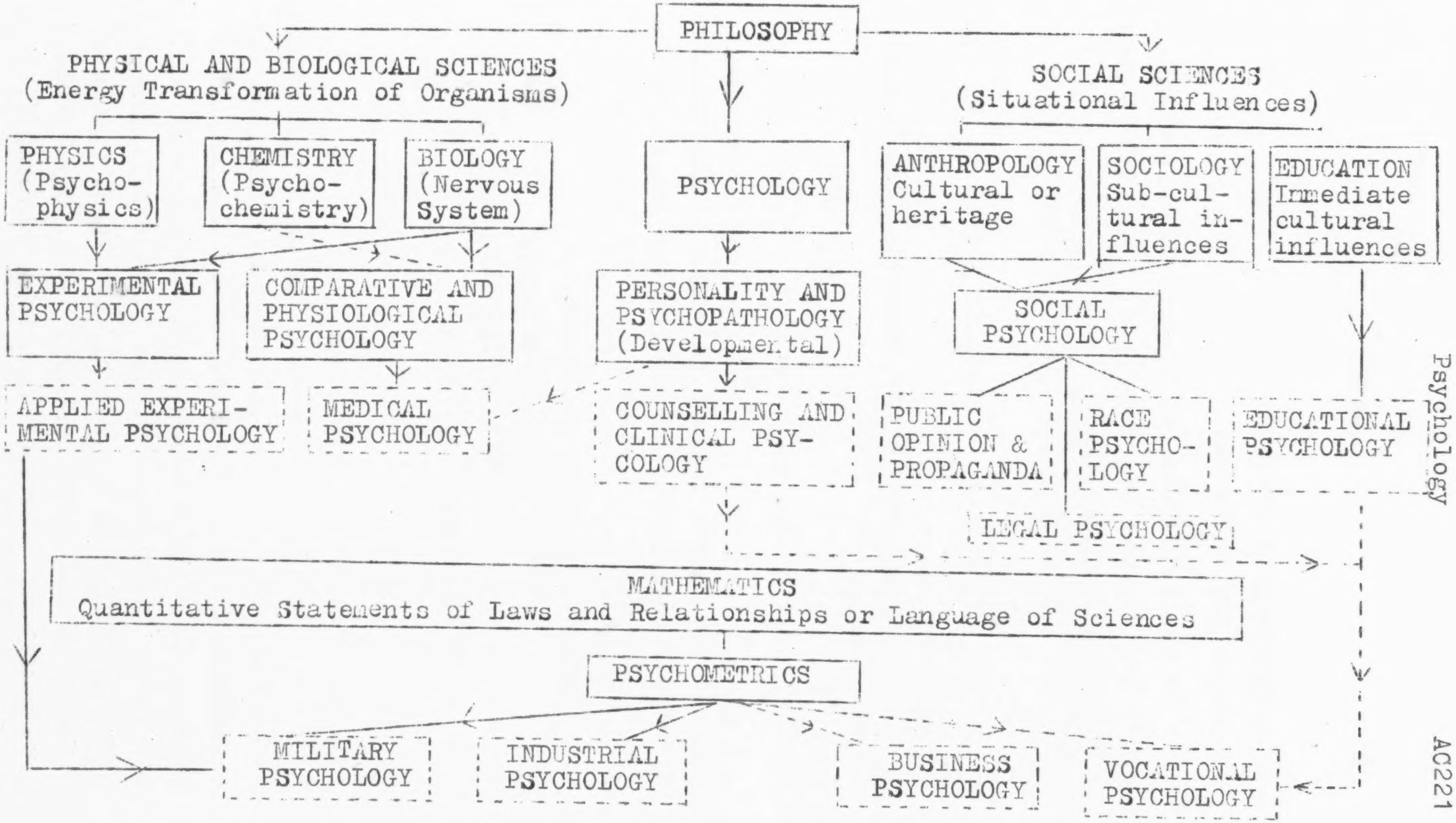
Thus, along an imaginary horizontal axis, we get the Natural Sciences -- Biology, Anatomy and Physiology in particular. Less closely related are the subjects Physics and Chemistry. Similarly, we note the relation of Psychology to Anthropology, Sociology, and Education.

Along an imaginary vertical axis, we may note that Psychology has been continuously striving for greater and greater quantification.

The major fields of study usually denoted as the "pure" fields of Psychology are indicated by solid line rectangles. Most of these fields appear to have grown out of alliances with the Natural and Social Sciences. The major fields of application of Psychology are indicated by broken line reactangles.

The connecting solid lines indicate the major influences that were important in the development of a given field. The connecting broken lines denote secondary influences (8).

221 Major fields and applications of Psychology


PHILOSOPHY
PHYSICAL AND BIOLOGICAL SCIENCES (Energy Transformation of Organisms)
SOCIAL SCIENCES (Situational Influences)
PHYSICS (Psycho-physics)
CHEMISTRY (Psycho-chemistry)
BIOLOGY (Nervous System)
PSYCHOLOGY
ANTHROPOLOGY Cultural or heritage
SOCIOLOGY Sub-cultural influences
EDUCATION Immediate cultural influences
EXPERIMENTAL PSYCHOLOGY
COMPARATIVE AND PHYSIOLOGICAL PSYCHOLOGY
PERSONALITY AND PSYCHOPATHOLOGY (Developmental)
SOCIAL PSYCHOLOGY
APPLIED EXPERIMENTAL PSYCHOLOGY
MEDICAL PSYCHOLOGY
COUNSELLING AND CLINICAL PSYCOLOGY
PUBLIC OPINION & PROPAGANDA
RACE PSYCHOLOGY
EDUCATIONAL PSYCHOLOGY
LEGAL PSYCHOLOGY
MATHEMATICS
Quantitative Statements of Laws and Relationships or Language of Sciences
PSYCHOMETRICS
MILITARY PSYCHOLOGY
INDUSTRIAL PSYCHOLOGY
BUSINESS PSYCHOLOGY
VOCATIONAL PSYCHOLOGY

3 DEVELOPMENTAL HISTORY

31 Three Major Periods

In the developmental history of Psychology, three major periods may be recognised. They are, however, overlapping. These are:

1 The philosophical, from Descartes (1650) to Fechner (1860);

2 The Systematic, from Wundt (1875) to McDougall (1923); and

3 The Specification and Factual, from Tolman (1932) onwards.

32 Kinds of Treatment

The developmental history of Psychology may also be considered roughly in terms of the Spiral of Scientific Method (4). Here, one can recognise four major kinds of treatment of the subject:

1 Religion-based psychology,
2 Philosophy-based psychology;
3 Experimental and empirical; and
4 System-based Psychology.

33 Early Development

331 Religion-based Psychology

The mode of thinking in Religion is essentially authority-centred. What is named as Religious Psychology deals with the study of the phenomenon of Religion in individual, groups, and races of man. The basic sacred books of most of the Religions have some psychological element in it. These elements constituted the religion-based psychology. Indeed some religions canalised thinking. Naturally, this left its own colour, so to speak, in the psychological concepts based on Religion.

332 Philosophy-based Origin

Till as late as the nineteenth century, Psychology was usually taken as a subdiscipline of the all-embracing discipline Philosophy. The philosophical questions, which are essentially speculative in nature, of particular relevance to Psychology, fall in the field of Epistemology. Contemporary discussion about consciousness, relation of psychological function to structure, Phenomenology, and the Self involve such questions.

34 Empirical Studies and Measurement

With the developments in Physics and Physiology in the eighteenth century, physicists and physiologists became interested to find out whether both physical phenomena and mental activity followed certain laws. For this, they made experiments and measurements in psychology. The following are some of the significant contributions to experimental and empirical studies.

Approx year of contribution	Contributor and the field of contribution
1760	Pierre Bouguer:- Measurement of the threshold for visual brightness. (Beginnings of Psychophysics).
1827	Joseph Delezenne:- Measurement of differential threshold for tonal pitch.
1334	Heinrich Weber:- Just noticeable difference of stimulus intensity is a constant fraction of the total intensity at which it is measured. (Weber's Law).

Approx year of contribution	Contributor and field of contribution
1850's	H Von Helmholtz:- Theoretical work on perception, audition, and vision.
1860	G T Fechner:- Formalisation of the method of determining threshold.
1872	Ferdinand Plateau:- Measurement of sensation.
1874	Franz Brentano:- Advanced the cause of Phenomenology. Intensional Psychology.
1883	Leopold Delboeuf:- Expanded Plateau's theory of sensory measurement in terms of the "sensed contrast" between sensations.
1885	H Ebbinghaus:- Quantitative techniques in the study of memory and learning.
1886	James Ward:- Extended the work of Brentano on Phenomenology.
1890	J M Cattel:- Mental tests and measurements.
1896	G E Mueller:- Psychophysical axioms.
1901	O Kuelpe:- Experimental study of thought process.
1905	E B Titchner:- Concept of sense distance and theory of supraliminal sensory interval.
1918	R S Woodworth:- Dynamic psychology.
1923	William McDougall:- Purposive behaviour.

35 Systems-based Psychology

Psychology developed into an experimental science about 1875, with the establishment of a laboratory by the physiologist Wilhelm Wundt in Leipzig in 1879 and by G Stanley Hall, a student of the physician William James, and of Wundt, in USA, in 1883. Psychology moved progressively to find answers to questions about mind and body relation, consciousness, the unconscious processes, and to emphasising that behaviour alone is available for study by science and that constructs such as "mind" either refer to non-existents or are irrelevant.

351 Psychoanalysis

For several centuries, philosophers have considered such issues as human motivation, the role of emotional behaviour, the basis of aesthetic choice and the ethical aspect of human nature. But it was Sigmund Freud (1856-1939) who developed a complex theory of the unconscious determinants of behaviour and applied it in the therapeutic process of psychoanalysis, and in the case of the emotionally disturbed and mentally ill. Since the 1920's, Freud's work has had a great impact on clinical medicine and on several other fields of the Natural Sciences as well as on Humanities and Social Sciences. The following are some of the significant contributions of the Psychoanalytical School.

Approx year of contribution	Contributor and the field of contribution
1895	Josef Breuer and Sigmund Freud:- In their book 'Studien uber Hysterie', they explained the "Cathartic" method of treatment to cure hysteric patients, which was the starting point what later became psychoanalysis.

Approx Year of contribution	Contributor and the field of contribution
1900	Sigmund Freud:- Interpretation of dream. Concept of unconscious and hidden motive.
1905	--: Theory of sex.
1911	Alfred Adler:- Concept of inferiority complex.
1915	Sandor Frenzi:- Concept of love.
1916	Carl G Jung:- He asserted that libido, which Freud emphasised to be primarily a sexual drive, was not in itself a sexual force, but a general life force, and that sexuality was merely one aspect of its function. Moreover, Freud stressed the role of universal personality dynamics -- energy patterns characteristic of all human experience. Jung divided personality into 'extrovert' and 'introvert' types. He considered the unconsious and the conscious to be the partners rather than in conflict with one another. He also emphasised on somewhat mystic concepts of spiritual forces and spiritual dectiny. On the basis of these ideas, he established a system of Analytical Psychology (Typological) -- a variant of Psychoenalysis of Freud, his teacher.
1920	Sigmund Freud:- Theory of Psychoanalysis. Alfred Adler:- Theory of Individual Psychology. He did not share Freud's belief in the supremacy of the sexual instinct. He put attention to tactics and strategy of life. He explained the main source of human striving to be striving for power, which essentially was social recognition and prestige. He also emphasised on the role played by body deficiencies in the formation of neurotic disorders. He believed that all forms of neurosis and developmental failure are expressions of inferiority complex and disappointment on firm basis. Thus his

Approx year of contribution	Contributor and the field of contribution
	approach to the emotional disorders was on the basis of Individual Psychology. It may, therefore, be said that he established the system of 'Individual Psychology' -- a variant of Psychoanalysis of Freud, his teacher.
1921	Sigmund Freud:- Concept of libido and its phases.
1923	--:- Concept of superego, ego and id.
1930's	Otto Rank:- Cause of neurosis in relation to anxiety during birth.
1939	K Horney:- Neurotic trends and role of anxiety.
1943	Erich Fromm.- Role of socio-economic structure on character development.
1947	H S Sullivan:- Defined Psychiatry and Psychoanalysis as the study of "Interpersonal relations".

352 Behaviourism

The studies of the kind mentioned in Sec 35 led to the development of the Behaviouristic School of J B Watson in the 1910's. It was a kind of revolt against introspection of Wundt and others and mentalism of Brentano and followers. Their view of behaviour is based on a connection of the stimulus with the motor response through a nervous arc; the more complex behaviour being built up by elaborating the simple nervous elements. Thought is associated with organs of speech and not with the brain. The following are some of the significant contributions of the Behaviouristic System of Psychology.

Approx year of contribution	Contributor and the field of contribution
1904	I P Pavlov:- Conditioned reflexes.
1913	J B Watson:- Behaviourism. Personality.
1915	E B Holt:- Response as the essence of cognition.
1929	K S Lashley:- Brain mechanism and intelligence.
1932	E C Tolman:- Purposive behaviour in man and animal.
1937	C L Hull:- Mind, mechanism and adapted behaviour.
1938	E C Tolman:- Intervening variables (Statistical approach).
1938	B F Skinner:- Skinner Boxes.
1943	C L Hull:- Quantitative theory of simple and complex forms of learning and behaviour.
1944	E C Tolman:- Stimulus-expectancy-need-cathexis.
1956	K W Spence:- Behaviour theory and conditioning.

353 Gestalt

The Gestalt School, which originated in Germany about 1912, challenged the Behaviourists. They experimented mainly with the process of perception, emphasising the role of the brain in organising sensation. Behaviour is viewed as taking place in a "field" of forces. Organised subjective experience was taken to be mirrored by a comparable "Isomorphic physical process" with a similar organisation in the brain. The following are some of the significant contributions of the Gestalt School.

Approx year of contribution	Contributor and the field of contribution
1912	Max Wertheimer:- Isomorphic relation between seen-movement and cortical short circuit.
1914	K Koffka:- Special features of mental growth.
1920	W Koehler:- Physiological isomorphism.
1923	Max Wertheimer:- Objects as immediately given to consciousness.
1930's	W Koehler:- Identity of field structure of psychological experience and underlying brain process.
1935	K Koffka:- Gestalt theory covering bearing memory, emotion, voluntary and involuntary action.
1940's to 1950's	K Lewin:- Structure of mind. Field theory. As some of the newer viewpoints in physics and mathematics made inroads in psychology, a fresh approach to Gestalt factors arose in the field theory of Kurt Lewin, who visualised psychological activities as events occurring within a frame of reference which could be represented geometrically. He mentioned about a 'psychological space', sometimes called hodological space within which goal-striving activities could be pictured. This space could be thought of as compartmentalised into subregions. And the techniques of that branch of mathematics, known as topology, could be employed fruitfully to diagram the interrelations of competitive goal-seeking activities within a larger field. The result was a technique for depicting graphically rather than verbally a variety of goal-seeking drives.

36 Current Trends

In recent years, some of the concepts of Psychology have been clarified by the findings of research in the field of Cytology, Neuro-chemistry, and Neurophysiology. The use of powerful electronic instruments has facilitated the measurement of responses to stimuli by the organs of the brain. The effect and the use of variety of drugs affecting the mind and the nervous system is another field currently receiving considerable attention. The study of Extra-Sensory Perception (Supersensories) has also received a fillip. The mechanisms of feed-back, self-regulations (Homeostasis), and Man-Machine relation, are also receiving considerable attention in studies in the subject of Cybernetics.

37 Rate of Increase of Contributions

The following table gives data on the number of significant contributions to Psychology during the past three and a half centuries.

SN	Period	N of Years	N of contributions	Approx N of contributions per 10-year period
1	1600-1699	100	12	1
2	1700-1799	100	12	1
3	1800-1899	100	68	7
4	1900-1965	65	254	40

371 Annotation

1 In the seventeenth and the eighteenth centuries, the rate of contribution of significant ideas to the field of Psychology remained more or less one per decade.

1 In the nineteenth century, the period of empirical studies and measurements, the rate of contribution increased nearly seven times over that of the previous century.

3 In the twentieth century, marked by the development of different systems of Psychology, the rate of contribution increased nearly six times over that of the nineteenth century.

4/5 CONTENT OF PSYCHOLOGY

4 WHAT PSYCHOLOGIST STUDIES

41 General Framework

The human individual is an organised system made up of several sub-systems. The system continuously attempts to maintain equilibrium between the input and output of each of its constituent subsystems and the overall stability in a continuous flux of inputs from and outputs to the environment. This individual system is a sub-system of larger systems, such as the family, bigger groups, and total society. The state of any of the units at a given point of time is the resultant of its genetic constituents and the past inputs to it. The interrelationship among the different branches and topics of Psychology can be viewed against the background of this general framework. Some of the ideas falling in the field of Psychology are mentioned in the succeeding sections.

42 Input Process

1 Sensation is the input of a stimuli through the sense organs -- for example, the sense of vision, hearing, smell, taste, and touch.

2 Perception is the organisation of the sensations into an "experience".

3 Apperception is the process by which perceptions are made meaningful through association with memory of related past experience.

4 Supersensorics (See Paper AA, Sec 72).

43 Central Process

The central processes are internal processes regulating the behaviour of the organism.

1 Learning and Memory are concerned with the storage of experience for periods of time.

2 Attention is a function which results in certain kind of input having more influence on the organism than another.

3 Higher Mental Processes include reasoning, decision-making, problem-solving and concept formation, all of which are characteristic of man, achieved through his complex central nervous system.

4 Emotion, Temperament, and Feeling are associated with the autonomic nervous system.

5 Motivation is concerned with the internal needs and drives which provide the impetus for action.

6 Personality is a complex idea similar but not identical with Self and Ego. It denotes the totality of all the characteristics that makes an individual unique, dependable in his responses, and therefore, recognisable as distinct from others over long periods.

44 Output Process

The output processes of the individual include such responses as his reflexes and physical acts, pattern of work and of fatigue, distraction, motivation and social interactions and his modes of communication.

5 METHODS AND TECHNIQUES

The various methods used by the psychologist in his investigations may be grouped into three categories:

1 Experimental
  - 11 Control-Test Method;
  - 12 Control-Group Method;
  - 13 Match-Paired Method;
  - 14 Practice Method; and
  - 15 Rotation Method.

2 Differential Method
  - 21 Co-relation;
  - 22 Longitudinal and cross-sectional approach; and
  - 23 Other statistical methods.

3 Clinical Method

Given below is a list of the different techniques used by the psychologist:

1 Direct Observation, including the use of recording devices such as the photographic camera, psycho-galvanometer and some of the instruments of the physician;

2 Controlled experiment;

3 Comparative technique;

4 Introspection;

5 Questionnaire method;

6 Interview. In clinical and psychotherapeutic interview, hypnosis, narcosis, and controlled and free association techniques may be used;

7 Situation tests, such as stress interview;

8 Psychometry;

9 Statistical analysis; and

10 Diagnostic and therapeutic techniques including Play Therapy and Role Playing.

6 SUMMARY OF ATTRIBUTES

61 Psychology as Study of Behaviour

From the description in the preceding sections we may summarise that Psychology deals essentially with the origin, development, and modification of behaviour. It includes the genetic and physiological basis of behaviour; the social and cultural settings in which behaviour occurs; learning theory and modification of behaviour via learning, personality theory and motivational forces producing normal and abnormal behaviour; measurement theory and methods for quantification of behaviour; experimental and statistical methods for assessing and predicting behaviour under defined conditions.

62 Postulates of Psychology

The following are some of the postulates, which according to Vinacke (17), characterise modern thinking in Psychology. In some cases, the postulates appear to be findings of research in the field of Psychology. Therefore, it is not quite clear the sense in which Vinacke uses the term 'Postulate'.

1 Postulate of the Material of Behaviour.- The same fundamental variables are present in total behaviour of all human beings, although all degrees of these variables may be observed; difference between individuals are largely differences of degree rather than of kind.

2 Postulate of Uniqueness.- Every individual as a total personality, is different from every other individual, as a result of past experience in conjunction with heredity, because no combination of factors is ever precisely the same for any two individuals.

3 Postulate of Normality.- "Normal" behaviour is a relative matter; it is that behaviour which characterises most people within a given cultural group (with certain privileged exceptions such as artist). "Abnormal" behaviour is extreme deviation from a given average point in terms of a defined variable, or group of variables.

4 Postulate of Physiological Concomitants.- Every manifestation of behaviour in an organism (here, the human being) occurs in association with some physiological change; no human behaviour can take place without some change in the organism.

5 Postulate of Heredity-Environment.- The human organism like all living things, is the joint product of heredity and environment; no aspect of the behaviour of an individual is entirely independent of either heredity or environment.

6 Postulate of Socialisation.- Human behaviour of any sort can be fully understood only in terms of the social context in which it developed and in which it functions.

7 Postulate of Objectivity.- No interpretation of human behaviour can be fully accepted unless it is founded on fact substantiated by scientific evidence.

8 Postulate of Finality.- In the study of

human behaviour, no interpretation, conclusion, or law is necessarily final, but is given in the light of the best present knowledge; allowance must be made for the possible operation of unknown or uncontrolled variables, and for other possible limitations of knowledge or outlook.

9 Postulate of Modification.- Human behaviour is not static; the individual develops and his behaviour is modified and remains modifiable as long as life continues.

10 Postulate of Measurement.- Potentially, all human behaviour can be measured and described.

11 Postulate of Diverse Views.- Human behaviour may be, and has been, interpreted from different viewpoints, no one of which is necessarily right or wrong, and all of which may contribute to complete understanding.

12 Postulate of Fractionation.- If, for convenience, aspects, or parts, of human behaviour are studied separately (or if apparently divisible units are analysed), it cannot be fully understood or described in terms of these elements, but must finally be viewed as a whole organisation.

13 Postulate of Dynamics.- All human behaviour has a cause.

7 PSYCHOLOGY AND CLASSIFICATION

71 Growing Literary Warrant for Psychology

In 1861-2 Wundt's Beitrage was published. In the same year, he conducted a new course in Psychology and his lectures were published in 1863. With the establishment of Wundt's Psychology Laboratory in Leipzig in 1879, the literary warrant on Psychology as a discipline independent of Philosophy had begun to increase at a great pace (See also Sec 37).

The periodical Mind was founded by the Mind Association of Edinburgh in 1876. It contained not merely articles in Philosophy, but also some distinctive articles in Psychology, more than the earlier periodicals in Philosophy. Before the end of the nineteenth century, nine more periodicals in Psychology were in publication. Karl Pearson in his Grammar of science (1876) had given Psychology a status coordinate with Philosophy. In 1881, Wundt started his Philosophische studien as the medium for the publication of the results of the work done in his Psychology Laboratory. Although the title contained the term 'Philosophy', perhaps this periodical may be considered as the first periodical on Psychology-quà-Psychology. It continued upto 1903. The second periodical he founded in 1905 was titled Psychologische studien. Between 1900 and 1960, as many as 115 periodicals had been started in different branches of Psychology. Departments and Chairs of Psychology were also established in some of the Universities in England and in Europe.

72 Main Class Status for Psychology

In spite of the starting of a periodical on Psychology in the 1880s, the wide recognition of Psychology as an independent discipline did not happen for nearly a generation thereafter. Therefore, library classification schemes including Dewey's DC, Cutter's Expansive Classification, Library of Congress Classification, and Brown's Subject Classification continued to treat Psychology as a division of Philosophy. However, the Colon Classification, which was designed much later -- as late as 1925 -- was able to recognise the new status gained by Psychology as an independent discipline. Therefore, it made it a Main Subject coordinate with Philosophy.

73 Source of Characteristics

A study of the developmental history of Psychology (See Sec 3) indicates that although Psychology was once a part of Philosophy, the characteristics for use in the division of the subject as a whole or some of its components may come from the subjects falling in any of the three major conventional divisions of the universe of subjects -- namely, the Natural Sciences, the Humanities, and the Social Sciences.

74 Position of Psychology in the Schedule of Basic Subjects

In an earlier discussion (5) on the position of Psychology in a schedule of Main Subjects, its position at the boundary line between the Humanities and the Social Sciences as found in CC was considered helpful although "Clinical Psychology" may claim close relation to the Medical Sciences and be so treated. Psychology's position in CC is also justifiable as falling in the general pattern of arrangement of the Main Subjects from Δ Spiritual Experience and Mysticism down to Z Law according to the Principle of Increasing Artificiality.

75 Isolates

The isolates that may have to be enumerated in the schedules of a scheme for the classification of subjects going with the Main Subject Psychology have been mentioned in Sec 4 and 5.

76 Basic Subjects

The following subjects have in recent years developed into self-sustaining disciplines and attracted considerable literary warrant. In a scheme for classification, each of them may claim treatment as a Basic Subject.

1 Social Psychology.- The study of interpersonal and group relationships, the influence of social and cultural factors, the place of the individual in society, and communication among individuals.

As a study of the behavioural attributes of society, Sociology may require the placing of Social psychology within its purview or in close juxtaposition to it. An equally similar **strong** claim could be made on behalf of Psychology. What can, however, be fairly well recognised, is that Social Psychology is likely to claim a Main Class status in the not distant future -- much sooner than Psychology did with respect to Philosophy.

2 Applied Psychology.- It is concerned with the application of the findings and the methods of psychology to solve the practical problems of human behaviour in business, education, military, political life, etc. The fields of applications include the following:

21 Psychology in treatment -- that is, clinical and counselling psychology;

22 Vocational guidance;

23 Engineering Psychology, concerned with human factors in engineering (Ergonomics) and Man-Machine relation;

24 Industrial Psychology.

25 Motivation Research; and

26 Forensic Psychology.

It is helpful to deem Applied Psychology as a Main Subject coordinate with Psychology. It should, however, find a position close to Psychology. The Main Subject Number may be constructed using Emptying Digits. The Number SX is suggested for Applied Psychology. It is mnemonic because Applied Psychology originated from and is widely used in industry.

In classification, a subject such as Clinical Psychology may be more helpfully placed in Medicine. Industrial Psychology may be deemed as a Specials Basic Subject, the Basic Subject Number being constructed using the schedule of Environment Isolates (1). Engineering Psychology and Forensic Psychology may each for the time being considered as Complex Subjects representing Bias Phase Relation.

77 Systems of Psychology

In dealing with the developmental history of Psychology (See Sec 3), only three major systems of psychology have been mentioned. Ideas such as Individual Psychology, Typological Psychology, Reflexology and Field Psychology, are shown as variants or major contributions in one or other of the three systems: Psychoanalysis, Behaviourism, and Gestalt. In a scheme for classification, a variant of a system may be treated as a variant or as an independent system (2). But the Canon of Ascertainability and the Canon of Permanence are likely to be violated if we adopt the former course. It is perhaps safer to adopt the latter course. For example, Adler's Individual Psychology (See Sec 351) may be treated as an independent system and not as a variant of Psychoanalysis.

Some subject specialists may look upon this as a violation of helpful sequence among the Systems of Psychology. They may require the parent system and its variants brought together in a chronological sequence. Therefore, if in a specialist library or for the time being even in a generalist library, there is demand for having together what are taken to be variants of one and the same system, that demand may be met administratively with the help of collection number without interfering with the Class Number (3).

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SPIRAL OF SCIENTIFIC METHOD: A CASE STUDY IN ITS APPLICATION.

H C REVANNASIDDAPPA, DRTC Trainee, 1969-70.

The mode of development of the Universe of Subjects is one of the factors affecting the design of a scheme for classification, and reference and documentation services. Some subjects are amenable for cultivation according to the Scientific Method. Such a development of a subject can be visualised in the form of the Spiral of Scientific Method. The helpfulness of the Spiral in learning about certain attributes of subjects is mentioned. Traces the developments leading to the formulation of the Law of Conservation of Mass-Energy in relation to the work in the four quadrants of the Spiral. The threat of failure of the Laws of Conservation of Mass and of Energy in the case of radioactivity and the solution given by the Special Theory of Relativity are mentioned. Failure of a fundamental law to account for a phenomenon is illustrated by the demonstration of the failure of the Law of Conservation of Strangeness and the Law of Conservation of Parity in the case of weak interactions among elementary particles. The rigorous testing done in recent years of all the Laws of Conservation at the level of elementary particles is mentioned. Some inferences are drawn about the subject Physics on the basis of the study reported in this paper.

0 DEVELOPMENT OF THE UNIVERSE OF SUBJECTS

01 Factors Affecting the Design of a Document Finding System

The design of a document finding system has to take into account the attributes of the

1 Universe of subjects; and

2 Universe of readers.

The specific attributes of the Universe of Subjects that affect the design of the document finding system are the

1 Mode of development; and
2 Structure

The mode of development of the Universe of Subjects may be considered in different ways. The work of developing some segments of the Universe of Subjects may conform to what is generally known as the scientific method.

02 Spiral of Scientific Method

The mode of cultivation of the Universe of Subjects according to the scientific method can be visualised in the form of a never-ending spiral -- that is, the Spiral of Scientific Method. Fig 1 represents the Spiral of Scientific Method. A description of the work in each of the quadrants of the Spiral has been given in detail elsewhere (2).

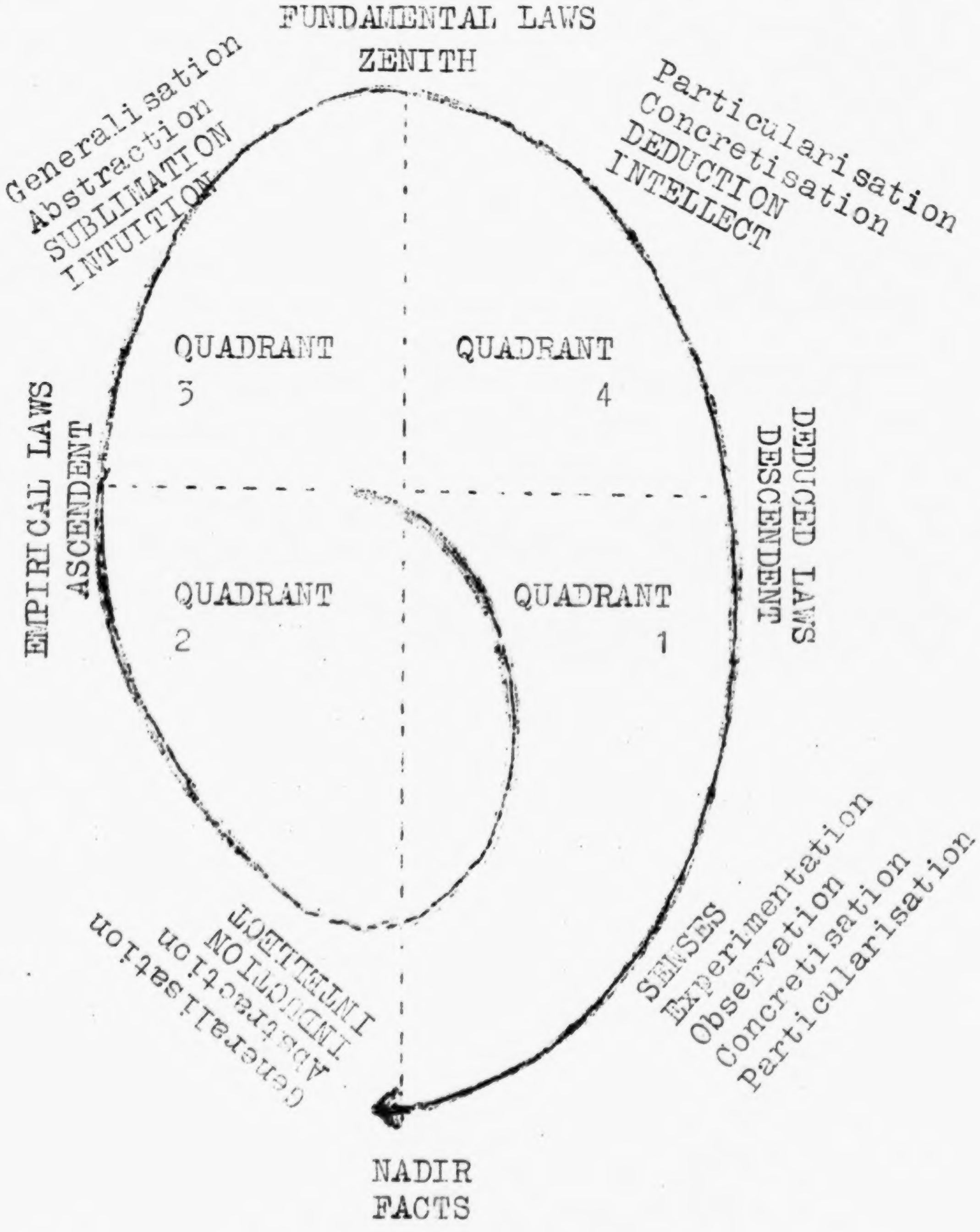
Fig 1. Spiral of Scientific Method (See next page)

03 Helpfulness

Some of the attributes and the helpfulness of the Spiral of Scientific Method in the Study of the development of the Universe of Subjects have been mentioned in another paper (1). With particular reference to the study of the attributes of subjects which are amenable for development according to the Spiral, it helps to:

1 Learn something about the intrinsic attributes of subjects. For example, that the basis of development being empirical -- starting from the collection of data, analysis of data; abstraction of empirical principles, through further generalisation (sublimation) to derive Fundamental Laws, to the formation of Deduced Laws; followed by prediction and guidance

Fig 1. SPIRAL OF SCIENTIFIC METHOD


FUNDAMENTAL LAWS
ZENITH
Generalisation
Abstraction
SUBLIMATION
INTUITION
Particularisation
Concretisation
DEDUCTION
INTELLECT
QUADRANT 3
QUADRANT 4
EMPIRICAL LAWS
ASCENDENT
DEDUCED LAWS
DESCENDENT
QUADRANT 2
QUADRANT 1
SENSES
Experimentation
Observation
Concretisation
Particularisation
INTELLECT
INDUCTION
Abstraction
Generalisation
NADIR
FACTS

in particular direction, validation or otherwise of the predictions on the basis of a large number of experiments; interpretation, correction, alteration, overthrow of fundamental laws and theories on the basis of the study of cases not in conformity with existing theory; and so on, each stage of development providing the problems for further development;

2 Learn about the stages of developments of a subject;

3 Understand better the kind of work involved and the kinds of ideas produced in the different stages of development of a subject;

4 Envisage the different patterns or modes of development in the Universe of Subjects;

5 Study comparatively the modes of development of different subjects and of groups of subjects;

6 Predict the likely trend of development in a subject in the near future. This will help in designing schemes for classification of the subject and in documentation service;

7 Examine the affinity among large regions of knowledge, such as those comprehended by each Basic Subject, Comprehensive Subject, Subject-Bundle, etc. This, in turn, will help the classificationist in placing these subjects in helpful positions in the Universe of Subjects and thereby in the scheme for its classification;

3 Observe the interaction between different subjects at the level of collection and use of data, and at the level of fundamental laws and their applications to specific cases in each of the subjects; and

9 Get a proper historical perspective of the development of a subject or of the Universe of Subjects as a whole.

04 Scope of the Paper

In this paper, a case study is presented tracing the development of a subject according to the Spiral of Scientific Method. In particular, the developments leading to and the formulation of some of the Laws of Conservation are dealt with (See also Sec 12).

1 CONSERVATION LAW

11 Definition

A Conservation Law is a statement that some physical quantity remains constant during processes and interactions working within an isolated system (3).

Many of the fundamental laws of nature can be stated as conservation laws. They are very powerful laws, for, they apply to almost all objects, large and small, in the universe. An elaborate structure of Physics has been built up with the Conservation Laws as the basis. They have also applications in several other subjects in the natural sciences.

12 Enumeration

The following are some of the Conservation Laws:

1 Conservation of momentum.

2 Conservation of angular momentum.

3 Conservation of mass-energy.

4 Conservation of electric charge.

5 Conservation of parity (for "strong" interactions).

6 Conservation of strangeness (for "strong" interactions).

7 Conservation of baryon number.

8 Conservation of lepton number.
9 Conservation of muon number.

In this paper, the Law of Conservation of Mass-Energy is dealt with in full -- that is, in relation to all the four quadrants of the Spiral of Scientific Method. The Law of Conservation of Strangeness and the Law of Conservation of Parity are given as examples of the failure of a fundamental Law to account for certain phenomenon.

2/5 APPLICATION OF SPIRAL OF SCIENTIFIC METHOD

2 CONSERVATION OF ENERGY

21 Experiment and Data (Quadrant 1)

211 While engaged in boring canons, Benjamin Thompson (later Count Rumford) (1753-1814), noticed that the blocks of metal grew hot as the boring tool gouged them out, so that they had to be cooled with water quite frequently. At that time, heat was considered a fluid (caloric) that could be poured from one container to another. From his many observations, Rumford concluded that the mechanical motion of the borer was being converted to heat and that heat was, therefore, a form of motion. He attempted to calculate the quantity of heat produced by a given quantity of mechanical energy. Rumford and his colleague Humphry Davy carried out further experiments on the melting of ice when rubbed mechanically.

212 James Prescott Joule (1818-89), who was almost a fanatic on the subject of measurement, devoted over a decade on measuring the heat produced by different kinds of processes. He churned water with paddles; he churned mercury with paddles; he pressed

water through small holes to heat it by friction; he did experiments in expanding and contracting gases; and he attempted to measure the temperature of water at different points in a water fall. In all these cases, he calculated the amount of work that had entered the system and the amount of heat that came out of it. He found that the two were closely related.

22 Empirical Principles (Quadrant 2)

221 Robert Mayer (1848-78) presented in 1842 a figure for the mechanical equivalent of heat and mentioned his belief in the conservation of energy. As a medical man, he included living organisms in the realm of energy conservation.

222 The first full description of the experiments and conclusions thereof by Joule appeared in 1847, wherein he propounded the idea of the "mechanical equivalent of heat".

223 Interconversion of energy.- By the end of the eighteenth century, new ideas about energy began to emerge. Alessandro Volta's invention of the battery in 1800 showed that electric current could come from chemical reactions. The electric current could produce heat and light, and through magnetism, it could produce motion. In turn, motion could produce electricity through friction. In 1822, Thomas Seebeck produced electric current by applying heat to the junction of two different metals. In 1834, Jean Peltier reversed this process showing that a current applied to such a junction could produce heat and cold.

224 Gottfried Wilhelm von Leibniz (1646-1716) and Rene Descartes (1596-1650) for many years worked

over the question of conservation of force. Descartes suggested measuring a force by the product "mv" which he called the quantity of motion. His assertion was that the total quantity of motion in the universe must remain constant. Leibniz, on the other hand, suggested (1686) that a force must be measured by the vis viva or energy in motion produced in an object when the force acted upon it through a certain distance. In 1743, Jean d'Alembert pointed out that a force could be measured either by the momentum it gave an object or by the energy. This implied that Descartes and Leibniz were each actually considering the conservation of two different entities -- momentum and energy.

225 The term 'Kinetic Energy' (energy of motion) was introduced by Lord Kelvin in 1856. It has been observed that when an object is moving upward, its momentum is steadily decreased by gravity. Its kinetic energy slowly disappears becoming equal to zero when the object reaches maximum height. However, the object also steadily gains "energy of position", high above the earth. The relation between the energy of position and force had been worked out in 1777 by Joseph Louis Lagrange. In 1853, W J M Rankine named this energy of position as 'Potential Energy'. Now, as the object starts falling, the potential energy diminishes and is converted into kinetic energy. When it reaches the ground, its potential energy becomes equal to zero and possesses all the kinetic energy with which it was thrown upward. It was, therefore, concluded that the kinetic energy plus potential energy of the object remained nearly the same during the course of its movement. This is the Principle of Conservation of Mechanical Energy.

23 Fundamental Law (Quadrant 3)

The interconversion of various forms of energy has been mentioned in Sec 324. This emphasised something that had been suspected from the time of Galileo and Newton. That is, energy could be neither created nor destroyed, but it is conserved. However, it had been observed in the earlier experiments that mechanical energy was not perfectly conserved. Some portion of the energy was lost to friction, to air resistance, etc. The experiments of Joule showed that such conservation could be made exact when the heat produced due to friction, etc was taken into account. This led to the formulation of the Laws of Conservation of Energy. Although Mayer and Joule had recognised the possibility of conservation of energy, the first person to present an explicit generalisation of it was Heinrich von Helmholtz in 1847. The Law of Conservation of Energy states: "Energy can neither be created nor destroyed, but it can be changed from one form to another."

3 DEDUCTIONS AND APPLICATIONS (Quadrant 4)

A few examples of the deductions from and applications of the Law of Conservation of Energy are mentioned in the succeeding sections.

31 Thermodynamics

The Law of Conservation of Energy is so important in connection with the study of the interaction of heat and work -- that is, the subject Thermodynamics founded about 1827 by Sadi Carnot (1796-1832) -- that it is often called the first Law of Thermodynamics.

The capacity of any system to do work is its "free energy". The portion of the energy that is unavoidably lost as non-useful heat, is represented in the measurement of "entropy", a concept developed by R J E Clausius in 1850. It is the Second Law of Thermodynamics.

32 Kinetic Theory of Gases

A better knowledge of the nature of heat came with the better understanding of the atomic nature of of matter. It developed from the realisation that the molecules composing a gas were in continual motion, bouncing off one another and off the walls of the container. In 1738, Daniel Bernoulli attempted to explain the properties of gases from this standpoint. But he was ahead of his times. It was only in the mid-nineteenth century that Clark Maxwell and Henri Boltzman worked out the mathematics of the process and established the Kinetic Theory of Gases. It showed heat to be equivalent to the motion of molecules.

321 Chemical Thermodynamics

The Kinetic Theory of Gases, in turn, led to the Theory of Chemical Thermodynamics worked out in detail by J W Gibbs in the 1870's.

33 Prediction

331 Discovery of Neutron

It was the Law of Conservation of Energy that led to the discovery of the neutron in 1932 by James Chadwick and his collaborators. Radio-active materials such as polonium and beryllium were found to give off a radiation that could penetrate even great thickness of lead. The same radiation, it was found, on hitting a paraffin piece, knocked out protons carrying energies upto 5 million electron volts. The question was where did all the energy come from.

Chadwick suggested that the phenomenon could be explained if it is supposed that the unknown radiation consisted of uncharged particles. A neutral particle could not be repelled by the electric forces of the atomic nuclei and therefore could pass through matter. If this particle carried a high amount of energy and had about the same mass as the proton, it could knock out a high energy proton when it collided with the nucleus of a hydrogen atom in the paraffin.

Chadwick's conjecture about the existence of the neutron was soon confirmed. This electrically neutral particle does not produce tracks in a cloud chamber or in other interactions that could detect it directly. But it enters into reaction with the atomic nuclei, resulting in the emission of photons and protons, which have a characteristic pattern identifying the neutron as the source.

332 Discovery of Neutrino

The Law of Conservation of Energy was again instrumental in predicting the existence of the neutrino. It was found that the beta particle given out by cobalt-60 or a similar nucleus, invariably carried less energy than it should. Further, some angular momentum was also lost because the spins of the particles did not add up to the theoretically expected value.

In 1930, Wolfgang Pauli suggested that if the Conservation Laws were valid, there should be another particle emerging from the nucleus along with the beta particle; and this hypothetical particle must carry the missing energy and spin. It was extremely difficult to detect such a particle with any of the devices then existing. For, it would be a particle with no measurable rest-mass, no electric charge, and almost no ability to interact with the other particles. However, physicists were convinced of the existence of the particle -- Neutrino, a name given to it by Enrico Fermi -- and they used it in their equations.

In 1956 the neutrino was detected. An elaborate particle detection system was set up close to the AEC nuclear reactor in Georgia (USA) with Frederick Raines and Clyde L Cowan in charge of the experiments. The radioactive pile was expected to produce a flux of neutrinos about thirty times more intense than that pouring from the sun. The set-up was to catch the reaction in which a proton absorbed a neutrino and is transformed into a neutron, becoming neutral in charge by emitting a positron. The idea worked and the existence of the neutrino was confirmed.

333 Antimatter

The Law of Conservation of Energy also helped in the work in the field of 'Antimatter'.

4 FAILURE OF CONSERVATION LAWS

41 Limits of Prediction

The confidence of the scientist in the fundamental laws of his subject rests on long and thorough experience. This is the case with the Conservation Laws also. For example, the conservation of energy, of momentum, and of electric charge, have been found to hold, within limits of accuracy of measurement, in every case that has been studied, including the field of elementary particles. An elaborate structure of the theoretical basis of physics has been built on these basic concepts, and its predictions have been confirmed without fail. One may, therefore, tend to forget that the Conservation Laws were after all based on empirical facts of experience. There is always the possibility that they may break-down when they are applied to new realms of physical phenomena. There may be other forces affecting a phenomenon not detected yet. They might not have been looked for in the right place. The power and accuracy of even the most powerful measuring instruments existing now will have limits. For instance, the Conservation Laws may not hold good on a cosmic scale. Therefore it can only be said that "long searching, cumulative experience entitles us to that there is an extremely high probability the laws are basically true" (7). Illustrative examples of the breakdown of two Conservation Laws in the case of elementary particles are given in the succeeding sections.

42 Conservation of Strangeness

421 Weak Interaction

The elementary particles have some properties that are conserved only approximately. This implies that the Conservation Laws for these properties hold on one time scale, but breakdown on a longer time scale. The "natural" period for interaction of elementary particles is about 10^{-23} second. This is the time-scale for the "strong" interactions which involve pions and nucleons. On the other hand, the "weak" interactions in radioactive decay involving emission of an electron and a neutrino take atleast 10^{-10} second to occur.

422 Law of Conservation of Strangeness

"Strangeness" is a property associated with the so called strange particles such as the lambda, the sigma, and the K. The Law of Conservation of Strangeness states that the total strangeness obtained by adding up the strangeness of the individual particles does not change after an interaction.

423 Failure

In 1957, Murray Gellman and E P Rosenbaum found that the total strangeness does not change in strong interactions, but need not be constant in weak interactions. The discovery of this exception to the law came at the same time as the discovery of the law itself.

43 Conservation of Parity

431 Parity

Parity is a property of elementary particles and atomic systems, derived from quantum mathematics. A particle or a group of particles is said to possess either 'even' or 'odd' parity.

432 Law of Conservation of Parity

The principle involved is the concept of "mirror symmetry". For example, two charged particles repelling each other appear identical whether one looks at them directly or at their image in a mirror. This is the case with an electric current and its magnetic field. All experiments showed that electromagnetic interactions have mirror symmetry. Applied to parity, in any interaction parity must be conserved -- that is, the total parity of the particles involved does not change. This law implies that an elementary particle will look exactly the same if it is twisted through half a revolution.

433 Failure

The Law of Conservation of Parity has been shown to be obeyed by all strong reactions. In 1956, T D Lee and C N Yang discovered a weak interaction, involving a beta decay of two mesons -- which apparently did not conserve parity. Their conjecture was confirmed by experiments by Chien-Shinng Wu at the Columbia University and other experimenters in other laboratories.

5 CRISIS AND RECOVERY

51 Attribute of Radioactive Elements

With the discovery of radioactivity in 1896, totally new kinds of energy and new questions about energy were encountered. The new phenomena seemed to threaten the Law of Conservation of Energy. One of the problems was concerned with the properties of radioactive elements. For example, radium gave out a little heat and there appeared to be a kind of spontaneous generation of energy within the atom. This potential energy was converted into kinetic energy of the particles given out during the radioactive breakdown of the atom. The twin problems were: the energy was apparently coming into existence out of nothing; and the mass of the atom was reduced. It appeared that one of the cornerstones of Physics -- the Law of Conservation of Mass -- was breaking down.

52 Special Theory of Relativity Provides Solution

The Special Theory of Relativity (1905) of Albert Einstein provided an explanation to the problem mentioned in Sec 51. It was deduced from the theory that a mass could be considered as a very concentrated form of energy or that energy possesses mass. This idea was applied to the radioactive nucleus. A very small quantity of mass would be converted into a very large quantity of energy.

Actually, every energy releasing chemical reaction changes a small amount of mass into energy. If the mass of the nucleus is measured before it disintegrated and the mass of all the particles that come out of it on disintegration -- including the kinetic energy of the particles and the energy of all the other forms of radiation that emanate -- then, these could add up to equal the original mass. The mass lost in ordinary chemical reaction is so small that suitable techniques were not available to the chemists of the nineteenth century to detect it. But physicists were dealing with nuclear energy of radioactivity. It released so much quantity of energy that the loss of mass was large enough to be measured. In general, every mass has a certain amount of energy connected with it, and every energy has a certain amount of mass. The connection between the two is given by Einstein's formula $E = mc^2$. Thus, in 1921, by postulating the interchange of mass and energy, Einstein generalised or merged the Law of Conservation of Energy and the Law of Conservation of Mass into a single Law -- that is, the Law of Conservation of Mass-Energy. The conversion of mass to energy was confirmed experimentally by F W Aston about 1925, using his mass spectrograph. The first Law of Thermodynamics was not only saved, but it became more unassailable than ever.

53 New Concepts

In order to describe reactions among elementary particles involving change in the mass of particles, the conservation of energy is taken in its modern form. It includes in the total energy, the "rest-energy" of the particles. In the equation $E = mc^2$, E denotes the rest-energy, m the rest-mass of the particles, c the speed of light. Different particles have different rest-masses, and therefore, different rest-energies. The total energy of a particle is the sum of this rest-energy, and the kinetic energy of motion. The latter is proportional to the rest-mass and it increases as the speed of the particle increases.

6 CONSERVATION LAWS AND ELEMENTARY PARTICLES

61 Rigorous Test

In the field of Particle Physics, the Law of Conservation of Energy was threatened at the turn of the century, as has been mentioned in the preceding section. In 1956, the Law of Conservation of Parity was shown not to hold true in the case of weak interactions among the elementary particles. Again in 1957, the Law of Strangeness met with the same fate. In the wake of these crises, physicists began testing more rigorously than ever before, the old and new Conservation Laws to find out whether they were valid in the realm of elementary particles. Thousands of laboratory experiments were done in different ways and all the quantities involved were accurately measured.

62 Mossbauer Effect

Particular mention may be made of the test by R L Mossabauer. In 1961, the Mossbauer Effect was used to check the validity of the Conservation of Energy and of Momentum with very great accuracy. It is concerned with the emission of gamma rays by 'excited' nuclei. The problem was to find out whether the total energy is conserved when a nucleus emits a gamma ray. The Mossbauer Effect provided a very accurate means of determining this. The Mössbauer Effect itself is a fine example of the conservation of energy.

7 SUMMARY OF HISTORICAL DEVELOPMENTS

The following is a summary of the ideas relating to the Conservation of Energy discussed in this paper, arranged in an approximate chronological sequence.

SN	Period	Contributor/Contribution
1	Seventeenth Century	Rene Descartes (1596-1650).- Idea of conservation of force. Suggested measuring a force by the product "mv", the quantity of motion. Gottfried Wilhelm von Leibniz (1646-1716).- Suggested measurement of force by the "energy of motion" (Vis viva). Conservation of energy was thought of from the time of Galileo and Newton.
2	1738	Daniel Bernouilli.- Properties of gases on the basis of movement of molecules.
3	1743	Jean d'Alembert.- A force could be measured either by the momentum of the object or by the energy.
4	1777	Joseph Louis Lagrange.- Mathematical relation between 'energy of position' and force.
5	1790s	Benjamin Thompson (Count Rumford).- Noticed, while boring cannons, that the block of metal grew hot. Inferred that the mechanical motion of the borer was being converted to heat, and heat was a form of energy.

SN	Period	Contributor/Contribution
6	1800-35	Ideas on inter-conversion of energy of various kinds. Volta (1800): Electricity from chemical reactions. Seeback (1822): Electricity from applying heat to metal junctions. Peltier (1834): Temperature difference caused by electricity.
7	1842	Robert Mayer.- Calculated figure for the mechanical equivalent of heat. Suggested conservation of energy even in living organisms.
8	1847	James Prescott Joule.- Full development of the concept of Mechanical Equivalent of Heat.
9	1847	Heinrich von Helmholz.- Explicit generalisation and statement of the Law of Conservation of Energy (First Law of Thermodynamics).
10	1850	R J E Clausius.- Concept of Entropy (Second Law of Thermodynamics).
11	1850's	Clark Maxwell and Henri Boltzman.- Kinetic Theory of Gases.
12	1853	W J M Rankine.- Named "energy of position" as Potential Energy.
13	1856	Lord Kelvin.- Named "energy of motion" as Kinetic Energy.
14	1870's	J Willard Gibbs.- Chemical Thermodynamics.
15	1900's	Apparent failure of the Law of Conservation of Energy in the case of radioactivity.
16	1905	Albert Einstein.- Special Theory of Relativity: Mass could be considered as a concentrated form of energy; a very small quantity of mass is converted into a very large quantity of energy. Concept of Rest-Mass and Rest-Energy.

SN	Period	Contributor/Contribution
		Merging of Laws of Conservation of Energy and of Mass into a single law -- the Law of Conservation of Mass-Energy.
17	1930s	Wolfgang Pauli.- Prediction of the existence of Neutrino on the basis of the Law of Conservation of Energy. Detection of Neutrino in 1956.
18	1932	James Chadwick.- Prediction of the existence of Neutron on the basis of the Law of Conservation of Energy.
19	1956	TD Lee and CN Yang.- Demonstration of failure of the Law of Conservation of Parity in weak interactions among elementary particles.
20	1957	Murray Gellman and E P Rosenbaum.- Demonstration of failure of the Law of Conservation of Strangeness in weak interactions among elementary particles.
21	1957-	Rigorous test of the Conservation Laws in the realm of elementary particles. Massbauer Effect (1961). Law of Conservation of Mass-Energy proved to hold good.

8 SOME INFERENCES FROM THE STUDY

From the study of the developments leading to the formulation of the Law of Conservation of Energy, we note that

1 Physics is a subject amenable for cultivation according to the Spiral of Scientific Method -- that is, its development follows the Scientific Method;

2 Physics has completed at least one cycle in the Spiral;

3 There is a close relation between subjects in the field of Physics and those in the field of Chemistry. This is seen in the matter of collection of

data for study and in the application of the Laws of Conservation;

4 Some Conservation Laws do not hold good in the case of elementary particles;

5 The development of new ideas becomes necessary for a correct explanation of the phenomenon observed (Example: Rest-mass, Rest-energy);

6 There is need for development of new and sophisticated instruments for the test and measurement to confirm or disprove predictions in fields not envisaged earlier;

7 The use of instruments and techniques so necessary in making advances in many subject-fields necessitates the cooperative action of a team of specialists in different subjects; and

8 The stage of development of the subject may indicate the likely trends in it in the near future.

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3 Sec 11 VAN NOSTRAND'S SCIENTIFIC encyclopedia. Ed 4. 1968. P 417.

Note.- The following documents have been used for information on the development of ideas relating to the Conservation Laws.

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RESOLUTION AND CLASS STABILITY OF PERPETUAL CLASSIFICATION IN ADAPTIVE DOCUMENT FINDING SYSTEM: A BRIEF REVIEW.

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The life-span of 'clusters' is influenced by certain operational constraints of the document finding system. The rate of growth of the universe of subjects is one factor. It is necessary to maintain a critical stability such that the perpetual class formation sustains a threshold resolution power without getting overloaded. The differences at the pressure points of utilisation of knowledge lead to strong and weak hierarchies in the cluster. The system of Complete Bibliography helps in developing a perpetual classification. Class stability, resolution, and model building based on the unified theory of value as they apply to document finding systems are briefly discussed. The usefulness and limitations of dynamic programming, operations research, Clump Analysis, and Latent Class Analysis, are mentioned. System design for use of computer in document finding and the efficiency of topological matching are referred to. The correlation of Kernel Ideas with the Five Fundamental Categories, is touched upon.

0 TERMINOLOGY

01 Adaptive Document Finding System.- A document finding systen with capacity to adapt itself to optimise its performance under the influence of an uncertain (changing) environment.

02 Perpetual Classification System.- A classification system which regenerates and reproduces itself, old forms (relations) being re-

placed by more efficient new forms (relations) in a perpetual succession of events.

03 Resolution.- The degree of precision with which a classification scheme can resolve two closely allied facets.

04 Class Stability.- The state of dynamic equilibrium when a cluster possesses sufficient resolution (a predetermined threshold value). It is represented by the period between the time of formation of a new cluster and the time when the cluster degenerates into new facets.

1 CLUSTER FORMATION

11 Influencing Factors

A Perpetual Classification is an important tool in document finding. It is also an aid in research. Its efficiency depends to a large extent on the precision of resolution. The influence which favours strong 'clustering tendencies' (11,20) and which declines after some time, and is replaced by other forces, favours a disintegration of the cluster. The period for which the cluster would remain stable can be denoted by the term 'life span of the cluster'. This life span is subject to certain 'Operational Constraints'; the analysis of this will be helpful. A study of the pattern of these events could throw light on the dynamic behaviour of cluster formation.

12 Growth of the Universe of Subjects

An important factor to be taken into account is the growth of the Universe of Subjects. The cumulated number of documents is doubling every eight to fifteen years; the number of professionals is also presently increasing at an exponential rate of about 7 per cent a year (15). Any document finding system, which ignores such rapid developments, is bound to become outdated very soon. This naturally implies a shift in emphasis from static to dynamic strategies -- a change from the so called 'subject content' to 'behaviour-oriented logic'.

2 CRITICAL STABILITY

The mechanisms whereby the growing universe of subjects remains in a state of equilibrium, are those of fragmentation (classification, clustering, grouping) and integration (hierarchic and other sequence relations and processes). As the population continues to grow and technology makes new strides, new facets of subjects develop. As the rate of growth of subjects increases, the influences responsible for instability of cluster increase. It is, therefore, necessary to maintain a 'critical stability' so that the cycle of perpetual class formation sustains a certain threshold resolution, without becoming overloaded. The cycle of rejuvination of classification will have to be suitably adjusted, to match the rate of growth of the universe of subjects. Depending upon the changes in the pressure points of utilisation of knowledge, the cluster would have 'strong or weak hierarchies'.

3 COMPLETE BIBLIOGRAPHY

In view of the possibility of constructing an appropriate logic-system suggested by Reinbach for describing the process of document finding, and the theorem that the document finding system cannot be represented by finite-valued system having single value truth table (6), it may be pointed out that the process of formation of complete bibliography inherits and preserves the 'system characteristics'. The establishment of limits of cluster, through the use of bibliographic coupling (14) does not disturb the infinite logic. As already pointed out in an earlier paper (13), the perpetual classification takes the complete bibliography as its essential basis. These limits do not depend only on bibliographic coupling, but also on 'subject limit co-relation'.

4 METHOD TO ACHIEVE PERPETUAL CLASSIFICATION

Bibliography, which is available on cards, is arranged operationally to find out the clustering tendencies (20). This results in grouping and re-grouping of documents, depending upon the hierarchial relations. Based on mutual relations of clusters and newly growing wave-fronts of knowledge which are responsible for this strategy of classification, the new cluster would come in sight and immediately suggest the scope of new class formation. At this stage, two possible models of the subjects can be recognised:

1 Model based on affinities to clustering or to scatter, of existing documents; and

2 Model based on likely-picture and the missing facets (forecast model).

This kind of operational analysis resembles a dynamic programming approach (1) and a kind of optimisation is achieved. The usefulness of this method of research prompted me to develop the method in detail. Study of the different hierarchies would indicate the direction to be followed in order to achieve an adaptive document finding system. Document finding systems are subjected to uncertain environments. This method establishes a feed-back to make it possible to optimise the decision structure. Comparison of the two models referred to above shows fruitful research areas.

5 CLASS STABILITY AND RESOLUTION

Stability and resolution are contradictory ideas. If we increase the resolution, clusters would have a tendency to become unstable (fragment). If, on the other hand, we allow the clusters to grow, it starts losing its utility as a research or search tool. A balance can be achieved by considering different factors, depending upon whether the subject field is active or comparatively dormant. Evidently, the cycle of revision of classification has to match with this activity.

6 MODEL BUILDING

Some features of document finding systems can be represented as:

1 Correlation graph;
2 Citation graph;
3 Weak and strong hierarchies; and
4 Topological relationship (3).

The prerequisite in establishing a model of document finding system is that environments must be standardised. The number of possible decision trees should be established (27). A well-defined strategy must be worked out. To keep these decision structures at their optimum, a 'commutative build-up' and adaptive strategy has to be developed.

This strategy can be built up taking into account the following factors:

1 Presenting an integrated picture of an individual preference, useful for guiding individual decision;

2 Resolving uncertainties that may attend an individual's belief about preferences;

3 Inter-relating the predictive and prescriptive facts of decision-making in a useful and consistent way;

4 Translating rough conception of worth and statements of objectives into precise value terms;

5 Describing the interaction of preferences among the factors of variables in multivariate alternatives;

6 Presenting a unified picture of the relationship between preferences and uncertainties regarding question of facts;

7 Describing the relationship and disparities between different and interacting value systems; and

8 Specifying a unified method for solving conflicting value systems.

61 Theory of Value

The above points are based on the 'Unified Theory of Value' (5). The significance of the evaluation of document has not been fully realised in the IR System Theory. Applications of Value Theory to the design of document finding system could be of help. Value of information arises from a joint consideration of probabilities and economic factors that affect decision. It is found that a numerical value can be assigned to elimination or reduction of uncertainty. Further, it is observed that joint elimination of uncertainty about even independent factors in a problem can have a value that differs from the sum of values of estimating uncertainty in each factor separately (7).

Developing a 'model for the process of learning to comprehend', Kochen and Uhr (16) conclude that "to be connected with its environment, it must sense and act. To have any reason for absorbing information, for becoming 'cognitive' in the first place, the assumption of a need-value system with a value-maximisation principle or something equivalent seems plausible".

7 WORK DONE

71 Mathematical Approach

Both from the point of view of research as well as establishing a perpetual classification, the application of dynamic programming and operational approach is necessary. General theory of document classification and factor analysis (2) involving an analysis and computation of occurrence and degree of association of Kernel Ideas enables document content comparison and determination of the number of categories required to describe a set of documents adequately. Clump analysis by Parker-Rhodes and Needham (20) in which the problem is to locate non-randomly associated terms in Boolean lattice of all possible subsets is not yet completely solved. Latent Class Analysis by Baker, in which patterns of key words are used to compute probable class identity, has not yet been empirically applied. It may be remarked that document finding system will not work in one-to-many transformation mode successfully because the necessary and sufficient conditions in normal mathematical work differ. The introduction of the use of the concept of complete bibliography makes it possible to achieve a balance between resolution and stability. It resembles an adaptive control system which possesses the ability to modify the classification scheme as well as the search strategy, to operate at an optimum level. The responsibility of arriving at a decision hierarchy is relegated to the human operator who would try to maintain the resolution at threshold level.

72 Class Stability Versus Obsolescence

In a recent study, a Markovian model is presented of a class of items with use-rate that is randomly distributed and with mean use or popularity that diminishes exponentially with time (19). It is shown that the yearly circulation of books in a library corresponds to this model. This enables the probabilistic prediction of the circulation characteristics of various kinds of documents in different subjects. Stability should not be confused with gradual obsolescence. Operational analysis shows the condition of obsolescence as it differs from stability. From the point of view of the economics of document finding system, this is of considerable help.

73 Information Theory and Systems Engineering

From the view-point of economics of computer usage (4,21,22,26,29), a completely empirical approach is likely to prove very costly. The system envisaged by the author is carefully adjusted to avoid semantic and syntactic degeneration and makes full use of the rate of growth of documents and indicates the gradual obsolescence (8-12). Representation of documents by graphs that consist of nodes and branches between nodes, giving relationship between keywords (23-25) represents a system situation. Matching document structures (28) with the structure of the query is not possible except through the establishment of a complete bibliography. From the point of view of information theory, topological matching yields greater efficiency than node-by-node or piece-by-piece comparison (3). Since the human operator takes into account different topologies, it naturally becomes a more efficient method. The inherent possibility to forecast the future makes it a potential research tool.

74 Correlation with Fundamental Categories

So far as the need for correlation of a Kernel Idea with one or the other of the five Fundamental Categories of S R Ranganathan is concerned, it may be conveniently done as long as it does not constrain the multivariate of natural growth. It is likely that one and the same isolate may have to be deemed to be a manifestation of more than one Fundamental Category in different contexts. In that event, we may be introducing an element of restriction in the classification if we deem a Kernel Idea to be a manifestation of one and the same Fundamental Category in all the cases. In perpetual classification, the scheme of classification is in a kind of perpetual dialogue with the growing universe of subjects; hence force-fitting of the isolates is minimum. The freely-faceted classification developed in India ensures this in a large measure. Since the entire strategy of class formation is geared to the attributes of the Universe of Subjects, there would be no difficulty in this regard. In the earlier part of the paper, mention has been made of 'strong' and 'weak' hierarchies. In the case of strong relations, decision-making is not very difficult. In the case of weak hierarchies, a slow rate of growth of the subjects is indicated and in course of time, the situation may crystallise.

8 ACKNOWLEDGMENT

The author gratefully acknowledges the part of the work done at the Technische Hochschule Darmstadt, German Centre for Computer Research and Testing of the Method, by Post-Graduate Students at the University of Roorkee.

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SUBJECTS PRESENTING RELATION BETWEEN TWO SUBJECTS, WITH PARTICULAR REFERENCE TO PHASE RELATION: CASE STUDY.

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In Complex Subjects presenting Bias Relation, there appears to be more advantages in having as the subject of Phase 1 the Biasing Subject rather than the Biased Subject as prescribed by CC. The Tool Phase is generally the one occurring earlier than Phase 1 in the CC schedule. The Influencing Phase is generally the one occurring later than the Influenced Phase in the CC schedule if the former is a subject in the field of Natural Sciences. The overall pattern of relation between Compound Subjects occurring in the form of Phase-Relation is discussed with examples. A number of subjects heretofore deemed as Complex Subjects are shown to be more helpfully classified using the concept of Matter-Property Isolate. This is illustrated using the Matter-Property Isolates "Basis" and "Interpretation". The problems in the classification of subjects such as Environmental Pediatrics and Environmental Embryology are examined. The occurrence of the Kernel Idea "Method" either as an isolate or as a qualifier in the context of different Compound Subjects is dealt with. Two ways of classifying Compound Subjects in the field of Psychosomatic Medicine are examined. It is helpful to deem

Psychosomatic Medicine as a Fused Main subject. In a Compound Subject involving the idea of "Evaluation" from the point of view of another idea or subject, it may be helpful to represent the latter as a Matter-Property Isolate.

Abbreviations Used:

(BCN) = Basic Class Number
(BS) = Basic Subject
CC = Colon Classification
CN = Class Number
[E] = Energy Isolate
(FC) = Fundamental Category
[MP] = Matter-Property Facet
[P] = Personality Facet
[S] = Space Isolate
[T] = Time Isolate

1 INTRODUCTION

11 Objective

The objectives of the work reported in this paper are to examine the following:

1 The different kinds of subjects embodied in books in which two subjects may be dealt with in relation to each other, with particular reference to Phase Relation -- that is, Complex Subject; and

2 The kinds of relation arising among the components of a subject falling in Category 1.

The discussion is confined mainly to CC.

12 Procedure

121 Selection of Books

About 16,000 books listed in the Publishers trade list annual for 1965 were scanned. If the subject of a book indicated that two subjects were treated in some relation to each other, then a Main Entry (without (CN)) was made for it on a standard catalogue slip. The selection of books was aided by the annotation given in the entry in the Annual. Wherever necessary, the annotation was noted in the catalogue entry. The locus of the document in the Annual was also noted in the entry to facilitate subsequent reference. A few books available in the DRTC Library have also been included in the study.

122 Facet Analysis

Each subject was facet-analysed. In facet-analysing, the Method of Postulates (5) upto Step 4 was followed and the result noted in the catalogue entry. Here is an example:

ANDERSON (C A), Ed.
Education and economic development.
1965.

[Annotation.- Contribution of
education to economic development
of USA].

Economics (BS); Development [1MP1].
USA [S1] influenced by Education (BS).

PTA. 1965. Aldine 1, 5

123 Sorting

The facet-analysed entries were sorted out, in the first instance, into two groups -- namely,

1 Subjects with Phase Relation; and
2 Subjects not involving Phase Relation.

The subjects in Group 1 "Phase Relation" were further sorted into the following sub-groups:

1 General Phase Relation;
2 Bias Phase Relation;
3 Comparison Phase Relation;
4 Difference Phase Relation;
5 Tool Phase Relation; and
6 Influencing Phase Relation.

The subjects in Group 2 "Not involving Phase Relation" were sorted into the following sub-groups:

1 Subjects with facet relation apparently involving two subjects; and
2 Other kinds of subjects.

13 Data on the Groups

131 Phase Relation

The following table gives data on the subjects involving Phase Relation.

Census of Phase Relation

SN	Group		Number	Percentage
1	General	..	22	18.2
2	Bias	..	44	33.0
3	Comparison	..	10	8.3
4	Difference	..	0	0.0
5	Tool	..	5	4.1
6	Influence	..	44	36.4

132 Annotation

1 Nearly 70 per cent of the Phase Relation is accounted for by Bias Relation and Influencing Phase Relation taken together. Each of these two kinds of Phase Relation has a nearly equal share in the percentage.

2 There was no subject with Difference Phase Relation.

3 The percentages of Comparison Phase Relation and Tool Phase Relation were relatively low.

4 The percentage of General Phase Relation is likely to be much less than 18.2 if the Phase Relation had been determined by a perusal of the books concerned.

133 Subjects not involving Phase Relation

The following table gives data on the subjects not involving Phase Relation:

Census of Subjects not involving Phase Relation

SN	Group	Number	Percentage
1	Subjects with Facet Relation apparently involving two subjects	72	54.9
2	Other kinds of subjects	61	45.1
	Total ..	133	100.0

2 SCOPE OF THE STUDY

21 Passive Phase Relation

The relation between two subjects may be considered as a General Phase Relation, if the kind of relation recognised is not definite or several kinds of relation are treated in a diffuse way. Therefore the subjects involving General Phase Relation are not examined further.

The Comparison Phase Relation and Difference Phase Relation do not raise special problems, say, in respect of the subject to be treated as first and second phases. Therefore, the subjects involving these two kinds of Phase Relations are not examined further.

The three kinds of Phase Relations mentioned above may be considered to be more or less "Passive Phase Relations".

22 Dynamic Phase Relation

Each of the Bias Phase Relation, Tool Phase Relation, and Influencing Phase Relation, is dynamic. For, in each of these cases, one subject produces some kind of impact on the other subject. The subjects involving these kinds of Phase Relation are examined further.

23 Subjects not involving Phase Relation

Subjects which might have been earlier taken as showing Phase Relation, but which can now be more appropriately classified as presenting only a facet relation among them, are discussed.

In the course of analysis of various subjects, a few new Property Isolates and Basic Subjects were recognised. These are also discussed in this paper.

3/6 PHASE RELATION

3 BIAS RELATION

31 Definition

A Bias Relation indicates that the exposition of the subject forming Phase 1 is biased towards the subject forming Phase 2. That is, the exposition of the subject forming Phase 1 is especially attuned or oriented or slanted either by selection or arrangement of topics or emphasis or standard or examples or other means, to the needs of specialists in the subject forming Phase 2.

32 Sequence of Subjects

According to the present practice of CC, in a Bias Relation, Phase 1 should be the subject whose exposition is biased towards the other subject. Phase 1 is called the Biased Phase and Phase 2 the Biasing Phase (1).

33 Kinds of Subjects in Bias Relation

Table 1 in Sec 91 gives examples of Bias Relation with the subjects in the two Phases arranged according to the present rule.

34 Annotation

341 Natural Sciences

A subject going with a particular (BS) among the subjects in the field of Natural Sciences ((BCN) A to L inclusive), is biased towards subjects going with a (BS) enumerated later in the schedule of (BS). That is, a relatively more abstract subject is biased towards a relatively more concrete subject.

342 Distilled Main Subjects

A subject going with a (BS) among the Natural Sciences may be biased towards a subject going with a Distilled Main Subject enumerated earlier to the former in the schedule of (BS).

A subject going with a Distilled Main Subject may be biased towards subjects going with (BS) enumerated either earlier or later in the schedule of (BS).

343 Humanities and Social Sciences

A subject going with a particular (BS) among the subjects in the field of Humanities or of Social Sciences may be biased towards subjects going with a (BS) enumerated earlier or later to the former in the schedule of (BS).

35 Sequence of Bias Phase Subjects

351 Biased Phase Determines Sequence

A Complex Subject exhibiting Bias Relation will get arranged among other subjects according to the subject forming its Phase 1 -- that is, the Biased Subject. For example, a book dealing with the subject "Psychology for teachers" will have "Psychology" as the (BS) in the Biased Phase (Phase 1) and "Education" as the (BS) in the Biasing Phase (Phase 2). Thus, this Complex Subject will get arranged among the books on Psychology.

352 Supporting Reasons

The reasons supporting the placing of the book among the books on the subject of the Biased Phase -- that is, Psychology in our example -- may be the following:

1 Subject of the book.- The subject of the book is essentially Psychology; only the exposition is biased towards Education. Therefore, when the classification is based primarily on the subject of books, this book should be placed among the books on Psychology.

2 Help to specialist in the subject of the Biased Phase.- The specialist in the subject of the Biased Phase -- Psychology in our example -- while browsing among the books on Psychology or among the Main Entries for them in the Classified Part of the Catalogue, will sense its exposition being biased towards various other subjects. This can suggest him new lines of work -- for example, getting the exposition of his subject biased towards subjects not yet covered in that way. This is an important service to specialist in the Biased Phase that a good classification can give.

3 Specialist in the subject of the Biasing Phase.- The Class Index Entries will help the specialist in the subject of the Biasing Phase -- Education in our example -- to sense the various subjects expounded with a bias towards his field of specialisation.

353 Opposing Reasons

1 Help to specialists in the subject of Bias Phase.- In the discussion in the preceding section, we considered only one category of users of the Complex Subject exhibiting Bias Relation -- that is, the specialist in the subject of the Biased Phase. We could also consider the helpfulness to other readers, in particular the specialists in the subject of the Biasing Phase.

When the exposition of the subject Psychology is specifically biased towards another subject Education, the resulting subject is intended to be of interest and use to the specialists in the subject Education. For a person with a particular subject as his field of primary specialisation, it is not easy to sense the various other subjects being expounded with a bias towards his field of specialisation. He may have to search quite extensively among several other subjects, if he is interested in this kind of inter-disciplinary work. There is now an increasing interest in such "inter-disciplinary" subjects. If the Complex Subject is placed among the subjects going with the (BS) forming the (BS) of the subject of the Biasing Phase -- the subject Education in our example --, there will then be more chances of the specialist in the subject of the Biasing Phase -- the intended user of the Complex Subject -- meeting with such subjects when he browses among the books or entries for them in his primary field of interest. He will come to recognise the different subjects that are biased towards his field of specialisation. It may even lead to his recognition of other subjects that could be biased towards his field. This benefit is similar to the one mentioned in Sec 352 with respect to the helpfulness to the specialist in the subject of the Biased Phase. It would thus appear that the arrangment of the Complex Subject by the subject forming Phase 2 is of comparatively of greater helpfulness to the intended reader of the Complex Subject. That is to say, it will have more number of readers there than if it were placed in the subject of the Biased Phase.

2 Development of Interrelation between the subjects.- In a study of the interaction between two Compound Subjects having different Host Main Subjects, we may sense the following stages of development:

1 General Phase relation;
2 Bias Phase relation;
3 Tool Phase relation;
4 Influence Phase relation; and
5 Fusion giving rise to a new Main Subject.

In this development, the establishment of the link between the two subjects may start at any one of the stages 1 to 4, or simultaneously at two or more stages.

Consider the relation between two Compound Subjects from Stage 2 onwards (Bias Relation onwards). It is seen that the subject forming the Biasing Phase is progressively affected to an increasing degree at the subsequent stages. The subjects representing the kinds of relation mentioned at Stages 3 and 4 will be placed with the subject of Phase 2 occurring in the Bias Relation.

Example.-

S&bT	Psychology biased to Education
T&eS	Psychology applied to Education
T&gS	Psychology influencing Education

Thus, the Complex Subject resulting from the first loose link between the two Compound Subjects such as in the Bias Relation may get arranged in a position removed from the subjects resulting from the later stages in the development of the relation between the two subjects. It is generally considered helpful to place a subject in a position among other subjects according to the trend of the development in the former if that is known or can be predicted.

3 Actand-Action-Actor Principle.- The discussion in the preceding section indicates that in

a Bias Relation and its subsequent development into stronger relations between two Compound Subjects, it is the Biasing Subject that is progressively affected to an increasing extent. According to the Actand-Action-Actor Principle, the Complex Subject should be placed with the subject of the Biasing Phase.

It would thus appear that in a Bias Phase Relation, there are several advantages in having as the subject of Phase 1 the Biasing Subject rather than the Biased Subject. This would appear to satisfy the Laws of Library Science to a greater extent than can be achieved according to the present practice of having in Phase 1 the Biased Subject.

4 TOOL PHASE RELATION

41 Definition

Tool Phase Relation indicates the exposition of the subject of the Phase 1, with a subject of the Phase 2, as a tool.

42 Sequence of Subjects

The subject in the study of which another subject is used as a tool forms Phase 1. The subject that is used as a tool forms Phase 2 (3).

43 Kinds of Subjects involving Tool Phase Relation

Examples of Complex Subject involving Tool Phase Relation are given in Table 2 in Sec 92.

44 Annotation

In each of the seven subjects mentioned in Table 2, the (BS) of Phase 1 -- that is, the (BS) of the Applied-to Subject -- is the one occurring later in the schedule of (BS) in CC with respect to the (BS) of Phase 2 -- that is, the (BS) of the subject which is applied.

5 INFLUENCE RELATION

51 Definition

An Influence Relation indicates the exposition of the influence of one subject on another subject. (2)

52 Sequence of the Subjects

The subject that is influenced is taken as Phase 1. Phase 2 is called the Influencing Phase .

53 Kinds of Subjects with Influence Relation

Examples of Complex Subjects involving Influence Phase Relation are given in Table 3 in Sec 93.

54 Annotation

1 A subject going with a particular (BS) among the subjects falling in the field of Natural Sciences is generally influenced by subjects going with a (BS) enumerated later in the schedule of (BS).

2 A subject going with a particular (BS) among the subjects falling in the fields of Humanities and Social Sciences is influenced by the subjects going with a (BS) enumerated earlier or later to the (BS) in Phase 1, in the schedule of (BS).

6 OVERALL PICTURE

The chart given in Sec 94 presents an overall picture of the kinds of Phase Relations occurring in the Complex Subjects selected for study.

61 Annotation

1 Among the subjects falling in the field of Natural Sciences, the Bias Phase Relation appears to be relatively more predominant.

2 . Among the subjects falling in the fields of Humanities and Social Sciences, the Influence Phase Relation appears to be relatively more predominant.

3 Between the subjects falling in the field of Humanities and Social Sciences on the one hand, and those in the field of Natural Sciences on the other, the Influence Phase Relation appears to be relatively more predominant.

4 The subjects going with the Main Subject Medicine appear to be affected by developments in the subjects going with different (BS) ranging from "8 Management" at one end to "Y Sociology" at the other.

5 The Main Subject Mathematics and the (BS) in which it is Host Main Subject are usually "Donor Subjects". That is, in the Bias Phase Relation such a (BS) occurs in Phase 1 and in the Influence Phase Relation, it occurs in Phase 2.

7/8 SUBJECTS NOT INVOLVING PHASE RELATION

7 FACET RELATION

71 Use of Matter-Property Isolate

Prior to the development and extensive use of the concept of Matter-Property Isolate, the relation between the two subjects occurring in each of the subjects in Group 2 "Subjects not involving Phase Relation" (See Sec 123) would have generally been considered as a Phase Relation of one kind or other. With the concept of Matter-Property Isolate, it has become possible to pinpoint more specifically the kind of relation between the two subjects involved. One of the subjects may be treated as an isolate. Examples of such subjects are discussed in the succeeding sections.

72 Isolate Idea "Basis"

The Isolate Idea "Basis" is deemed to be a manifestation of the (FC) Matter -- that is, as a Matter-Property Isolate. The Isolate Term 'Basis' is used to denote also equivalent ideas such as "Foundation", "Principle", and "Theory". Examples of subjects involving the Isolate "Basis" is given in Table 4 in Sec 95. An indication is also given in the table as to the kind of Phase Relation that might have been represented in each of the subjects, had the Matter-Property Isolate "Bias" not been used.

721 Annotation

1 Each of the subject analyses in Col (c) in Table 4 expresses the specific subject of the document mentioned in Col (b) more coextensively than the corresponding analysis given in Col (d) representing a Phase Relation.

2 Some of the subjects represented as a Phase Relation would be placed in a position where they are relatively less likely to be looked for by the majority of the readers.

73 Isolate Idea "Interpretation"

The Isolate Idea "Interpretation" is deemed to be a manifestation of the (FC) Matter -- that is, as a Matter-Property Isolate. Subjects involving the Isolate Idea "Interpretation" are those in which one subject is interpreted -- that is, its meaning is expounded -- in terms of or in relation to another subject. The interpretation may not amount to evaluation of one subject from the point of view of another.

Examples of subjects involving the Isolate "Interpretation" are given in Table 5 in Sec 96. An indication is also given in the table as to the kind of Phase Relation or other relation that might have been used to represent each of the subjects, had the Matter-Property Isolate "Interpretation" not been used.

731 Annotation

1 By the use of the Matter-Property Isolate "Interpretation", it has been possible to differentiate a subject dealing with a strictly critical evaluation of one subject from the point of view of another, from the one in which one subject is interpreted in terms of another. This differentiation should be of help to the reader in the choice of documents. It is, of course, necessary to differentiate an "interpretation" from an "evaluation" by a perusal of the document concerned. A document may present a mixture of "interpretation" and "Evaluation". Then the dominant kind of treatment is to be considered. In a few cases, cross reference entries may become necessary.

2 In a majority of the examples, the interpretation of a subject is in terms of a subject in the field of Humanities -- particularly Religion and Philosophy.

74 Isolate Idea "Ecology"

741 "Environment" and "Ecology"

Consider the subjects of the following documents:

1 FISCHER (C C). Environmental pediatrics. 1960.
2 MINTZ (B), Ed. Environmental influences on prenatal development. 1958.

"Environment" is defined as the "assemblage of material factors and conditions surrounding the living organism and its component parts". There is an "internal environment" and an "external environment". The totality of the interactions between an organism and its environment is usually called the "ecology" of the organism. Here "environment" includes everything that is not an intrinsic part of the organism or group under consideration.

In example 1, the subject dealt with is the influence of and the child's reaction to, the environmental factors falling predominantly within the field of specialisation of medical men, particularly paediatricians. In example 2 also, the subject is similar, but instead of the "Child" the organism concerned is the "Embryo". Thus, in these two subjects, we recognise the idea of "ecology" in relation to "Child" and "Embryo" respectively. It is suggested that the idea of "ecology" be taken as a Matter-Property. Facet analysis of the two subjects will now yield:

1 Child Medicine (BS); Ecology [1MP1]
2 Embryology (BS); Ecology [1MP1]

The term 'Ecology' can be replaced, if necessary, with a more appropriate and current term, such as 'Environmental factor'.

742 Compound Basic Subject

A Compound (BS) may be considered for each of the subjects mentioned in Sec 741. For example,

L9L-9C Environmental Paediatric Medicine
G9L-9B Environmental Embryology

However, such a Compound (BS) would be appropriate if the subject is the study of the organism in a non-normal environment. For instance, for a deep sea fish, the sea surface would be a non-normal environment. For a person normally living on the plains, high altitude condition such as on a high mountain will be a non-normal environment. Thus, "Environmented Specials" stand for non-normal environment. This does apply to the two subjects mentioned above. The facet-analysis suggested in Sec 741 for each of the subjects is more expressive and helpful.

8 OTHER SUBJECTS

81 Subjects involving "Method"

Consider the subject "Numerical Method of Reactor Analysis". Here, "Numerical Method" is a subject occurring as a Kernel Idea denoting a method of analysis of data on Reactor Design. The latter subject goes with the Host Subject Reactor Production Engineering. Thus, a "Method" is said to occur in a Compound Subject when another subject occurs in it as a Kernel Idea usually representing a procedure for doing something.

82 Definition

The meaning of "Method" used in this paper is "A process or procedure for doing anything".

83 Occurrence in Subjects

The following ideas have been found helpful in classifying subjects involving the Kernel Idea "Method".

1 The Kernel Ideas "Process", "Procedure", "Way of Performing" may be taken to be equivalent to the idea denoted by "Method".

2 In a subject

21 A Kernel Idea may represent a specific Method, as in "Chromatographic Method of Analysis of Amino Acids";

22 The generic term 'Method' may occur as in "Methods of Protein Analysis"; or

23 The idea of Method may not be explicitly stated as in "Chromatography of Amino Acids";

3 A "Method" is used to do something. This implies that in a Compound Subject, a Kernel Idea usually precedes the "Method"; and

4 The Kernel Idea "Method" may occur as an Isolate or as a Qualifier in different subject contexts.

Examples:

1 Statistical analysis of advertising expenditure.

Facet analysis:
Economics (BS), Advertising business [1P1] ;
Expenditure [1MP1] : Analysis [1E],
Statistical method.

2 Graphical solution to linear differential equations.

Facet analysis:
Differential equation (BS), Linear [1P1] ;
Solution-Graphical method.

84 Examples

Table 6 in Sec 97 gives 21 examples of subjects in which a Kernel Idea representing a "Method" occurs.

85 Psychosomatic Medicine: Relation between Medicine and Psychology

851 Trend

Consider the subjects of the following documents:

1 JONES (A) and FREYBERGER (H), Ed. Advances in psychosomatic medicine. 1961.

2 MANHOLD (J H)(Jr). Introductory psychosomatic dentistry. 1956.

3 GENGERELLI (J A) and KIRNER (F J), Ed. Psychological variable in human cancer. 1954.

4 KROGER (W S). Psychosomatic obstetrics, gynecology, and endocrinology. 1962.

5 FLAHERTY (B E). Psychophysiological aspects of space flight. 1961.

"Psychosomatic medicine" is defined as that "aspect of medical science which stresses the psychobiological unity of the human being. The close interaction of mind and body in health and disease, and the role that the mind plays in the genesis of organic disease, form the basis of psychosomatic medicine".

There are now a large number and variety of subjects -- macro documents as well as micro documents -- considered to fall in the field of Psychosomatic Medicine. The trend of specialisation in the subject appears to be that of taking a wider view of the psychosomatic aspect of medicine than merely in the sense of a "psychological condition" producing some organic disease. In other words, "Psychosomatic medicine" is considered as a particular view or approach to the whole field of medicine, one in which the psychophysiological unity of the human being forms the basis. It may, therefore, be helpful to deem Psychosomatic Medicine as a Basic Subject. Dr Ranganathan has suggested that it could be considered as a Fused Main Subject (4).

852 Alternative Classification

It is also possible to consider the psychosomatic aspect as an attribute -- that is, as Matter-Property. The following table gives the five subjects mentioned in Sec 851, facet analysed in two ways.

SN	Facet Analysis with	
	Psychosomatic Medicine as a (BS)	"Psychosomatic factor" as Matter-Property
a	b	c
1	Psychosomatic medicine (BS)	Medicine (BS); Psychosomatic factors [1MP1]
2	Psychosomatic medicine (BS), Tooth [1P1]	Medicine (BS), Tooth [1P1] ; Psychosomatic factors [1MP1].

SN	Facet Analysis with	
	Psychosomatic Medicine as a (BS)	"Psychosomatic factor" as Matter-Property
a	b	c
3	Psychosomatic medicine (BS); Cancer [1MP1]	Medicine (BS); Cancer [1MP1] ; Psychosomatic factors [1MP2]
41	Psychosomatic Female medicine (BS); Obstetrics [1MP1]	Female medicine (BS); Obstetrics [1MP1] ; Psychosomatic factors [1MP2]
42	Psychsomatic - Female medicine (BS), Genito-urinary system [1P1]; Disease [1MP1]	Female medicine (BS), Genito-urinary system [1P1] ; Disease [1MP1] ; Psychosomatic factors [1MP2]
43	Psychosomatic-Female medicine (BS), Endocrine system [1P1]	Female medicine (BS), Endocrine system [1P1]; Psychosomatic factors [1MP1]
5	Psychosomatic-Space medicine (BS)	Space medicine (BS); Psychosomatic factors [1MP1]

The facet analysis given in Col (b) arranges all the documents involving the concept of "Psychosomatic medicine" together, whereas the facet analysis given in Col (c) places the documents involving the concept "Psychosomatic" medicine with the respective Host

Subjects. The relative helpfulness of the two arrangements to the specialists and the trend of specialisation in Psychosomatic Medicine should be examined in arriving at a decision to adopt one or the other method of classifying such subjects.

86 Isolate Idea "Evaluation"

The concept of "Evaluation of a subject from the point of view of another subject" has already been recognised and provided for in CC. The isolate idea "Evaluation" is deemed to be a manifestation of the fundamental category "Energy". The subject, the angle from which another subject is viewed, is deemed to be a manifestation of the Fundamental Category Personality and assigned to Round 2. But with the concept of "Property Isolate", the point of view from which a subject is evaluated may be deemed to be a manifestation of the fundamental category Matter-Property. The following table gives examples of subjects facet analysed in both the ways.

SN	Document Reference	Facet Analysis 1 (Personality)	Facet Analysis 2 (Property)
a	b	c	d
1	MEYERHOFF (H) Time in literature. 1955.	Literature (BS), English [1P1]: Evaluation [1E], Concept of Time [2P1]	Literature (BS) English [1P1]; (Concept of) Time [1MP1] : Evaluation [1E]

SN	Document Reference	Facet Analysis 1 (Personality)	Facet Analysis 2 (Property)
a	b	c	d
2	DE (S K). Sanskrit poetics as a study of aesthetic. 1963.	Literature (BS), English [1P1] ; Poetry [1P2] : Evaluation [1E], Concept of aesthetics [2P1]	Literature (BS), Sanskrit [1P1], Poetry [1P2] ; (Concept of) aesthetics [1MP1]: Evaluation [1E]
3	KILLINGER (J). Failure of theology in modern literature. 1965.	Literature (BS), English [1P1]; Evaluation [1E], Concept of theology [2P1]	Literature (BS), English [1P1]; (Concept of) Theology [1MP1] : Evaluation [1E]
4	HOWSE (EM). Spiritual values in Shakespeare. 1965.	Literature (BS), English [1P1]. Shakespeare [1P2]: Evaluation [E], Spiritual Value [2P1]	Literature (BS) English [1P1] Shakespeare [1P2]; Spiritual Value [1MP1]: Evaluation [1E]

According to the facet analysis given in Col (c), the evaluation of a particular subject from different angles will be brought together, whereas in the facet analysis given in Col (e), they will be scattered according to the concept taken as the attribute or property of the subject. The relative helpfulness of these two sequences is to be examined.

91 Table 1. Bias Phase Relation (&b): Examples

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
1	STRANG (R) and LINDQUIST (DM). Administrator and the improvement of reading. 1965	Reading method (BS) bias to Management (BS), Executive ⌈1P1⌋	3V	3,2,8
2	BLOOMER (R H). Reading comprehension for scientists. 1963.	Reading method (BS) bias to Natural sciences (BS)	3V	A
3	BOWERS (W F). Techniques in medical communication. 1963. ⌈Public speaking for medical men⌋	Public speaking (BS) bias to Medicine (BS)	9P75	L
4	FREEMAN (H). Mathematics for actuarial students etc. 1965.	Mathematics (BS) bias to Actuarial statistics (BS)	B	BP97
5	RIZER (C). Police mathematics. 1955.	Mathematics (BS) bias to Police (BS)	B	V,8(Y;4:61)
6	YAMANE (T). Mathematics for economists. 1954.	Mathematics (BS) bias to Economics.	B	X

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
7	AMES (V F), Ed. Non-linear partial differential equations in engineering. 1965.	Differential equation (BS) Non-linear-partial [1P1] bias to Engineering (BS)	B33,E,7	D
8	KHARBANDA (O P). Nomograms for chemical engineers. 1958.	Nomography (BS) bias to Chemical engineering (BS)	B44	DYE
9	BUSEMAN (H). Geometry of geodesics. 1955	Geometry (BS) bias to Geodesy (BS)	B6	HUB
10	MANNAL (C) and MATHER (N). Engineering aspects of magnetohydrodynamics. 1962.	Mechanics (BS), Liquid - Magnetic field [1P1] ; Dynamics [1MP1] bias to Engineering (BS)	B7,5-V;3	D
11	NELSON (B L). Elements of modern statistics for students of economics and business. 1965.	Statistics (BS) bias to Economics (BS)	BT	X

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
12	SARGEVANT (M J). Operations research for management. 1965.	Operations research (BS) bias to Management (BS)	BTT	8
13	WIENER (N) and SCHAEDE (J P). Progress in biocybernetics. 1964.	Cybernetics (BS) bias to Biology (BS)	BV	G
14	MASTURZO (A). Cybernetic medicine. 1965.	Cybernetics (BS) bias to Medicine (BS)	BV	L
15	ROGERS (J S). Physics for medical students	Physics (BS) bias to Medicine (BS)	C	L
16	SELMAN (J). Basic physics of radiation therapy. 1961.	Electromagnetic radiation (BS) bias to Medicine (BS); Disease [1MP1]: Treatment [1E], Radiation [2P1]	C5	L;4:6
17	EDELMAN (A), Ed. Radioactivity for pharmaceutical and allied laboratories. 1960.	Nuclear Physics (BS); Radioactivity [1MP1] bias to Pharmacognosy (BS)	C9B3;5	LX

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
18	SACKHEIM (G O). Introduction to chemistry for biology students. 1965.	Chemistry (BS) bias to Biology (BS)	E	G
19	NEVILLE (H A D) and NEWMAN (LF) Chemistry for agricultural students. 1965. 2V.	Chemistry (BS) bias to Agriculture (BS).	E	J
20	KLARMANN (E G). Cosmetic chemistry for dermatologists. 1962.	Production Technology (BS) Cosmetics [1P1] bias to Medicine (BS), Skin [1P1]	F8,95	L,87
21	HALMAN (E T) and HAMMOND (J). Physiology for agricultural students. 1965.	Biology (BS); Physiology [1MP1] bias to Agriculture (BS)	G;3	J
22	FROBISHER (M) and others. Microbiology for nurses.1964.	Microbiology (BS) bias to Nursing (BS)	GT	LY1

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
23	DIOGUARDI (N), Ed. First European symposium on medical enzymology, Milano, 1960-61.	Biochemistry (BS), Enzyme [1P1] bias to Medicine (BS)	GUE,982	L
24	GEORGE (J J). Weather forecasting for aeronautics. 1960.	Meteorology (BS), Weather [1P1]; Forecast [1MP1] bias to Aviation (BS)	HV7,1:28,91	MD53
25	DAVIES (P M). Medical terminology for radiographers. Ed 2. 1966.	Medicine (BS), Terminology [1MP1] bias to Medicine (BS); Disease [1MP1] : Diagnosis [1E], Physical-Radiography [2P1]	L;p34	L;4:3,2-53

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
26	CAMPBELL (H J). Brain and mind: Neurophysiology for psychiatrists. 1966.	Medicine (BS), Nervous system [1P1]; Physiology [1MP] bias to Medicine (BS), Nervous-system [1P1] ; Disease [1MP1]	L,7;3	L,7;4
27	SEIVERD (C E). Hematology for medical technologists. Ed 3. 1964.	Medicine (BS), Blood [1P1] bias to Medical technology (BS).	L,35	LT
28	CATTERALL (R D). Venereology for nurses. 1964.	Medicine (BS), Genito-urinary system [1P1]; Disease - venereal [1MP1] bias to Nursing (BS)	L,5;422	LY1

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
29	BRECHNER (V L) and others. Practical electroencephalography for the anesthesiologist. 1962.	Medicine (BS), Brain [1P1]; Function [1MP1]: Diagnosis EEG [1MP2] bias to Anesthesiology (BS).	L,72;3:3,26	LY7
30	ADRIANI (J). Fundamentals of general anesthesia for students and practitioners of dentistry. 1958.	Anesthesiology (BS) bias to Medicine (BS), Tooth [1P1]	LY7	L,214
31	MARTINS (J M). English for the foreign physician. 1965.	Linguistics (BS), English [1P1] bias to Medicine (BS), USA [S1], Professional-from outside USA [1P1]	P,111	L.73,b-(Y.395)
32	GUNNINGHAM (B V). Psychology for nurses. 1951.	Psychology (BS), bias to Nursing (BS).	S	LY1
33	GARRISON (K C) and others. Educational psychology. 1965.	Psychology (BS) bias to Education (BS)	S	T

92 Table 2. Tool-Phase Relation (&e): Examples

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
1	BRILLOUIN (L). Tensors in mechanics and elasticity. 1964.	Mechanics (BS) application of Tensor Calculus (BS).	B7	B463
		Properties of Matter (BS); Elasticity [1MP1] application of Tensor calculus (BS).	C2;2	B463
2	ARNOLD (Q W) and MOUNDER (L). Gyrodynamics and its engineering applications. 1961.	Engineering (BS) application of Mechanics (BS), Solid-Rotating [1P1]; Dynamics [1MP1].	D	B7,19B;25
3	DESIRANT (M) and MICHIELS (J L), Ed. Solid state physics in electronics and telecommunications. 1958.	Power Production engineering (BS), Electronic [1P1] application of Physics (BS), Solid [1P1]	D6,5	C2,1

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
		Service Production engineering (BS), Telecommunication [1P1] application of Physics (BS), Solid [1P1]	D7,65-P	C2,1
4	ARMSTRONG (C F). Soil mechanics in road construction. 1962.	Track engineering (BS), Road [1P1] application of Foundation engineering (BS), Soil [1P1]; Mechanics [1MP1]	D4,11	D12,1;2
5	RASHEVSKY (N). Some medical aspects of mathematical biology. 1960.	Medicine (BS) application of Biology (BS), Principles-Mathematics [1MP1]	L	G;Oa-(B)

93 Table 3. Influence Phase Relation (&g): Examples

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
1	FISKE (M). Book selection and censorship. 1959.	Library science (BS), Public library [1P1] ; Book selection [1MP1]. USA [S1] influenced by Law (BS), USA [1P1], Censorship-publication [1P2]	2,2;1.73	Z,73,5Z7
2	NICOLSON (M). Science and imagination. 1956.	Natural sciences (BS); Development [1MP1] influenced by Psychology (BS); Imagination [1MP1]	A;g7	S;43
3	AMIS (E S). Solvent effects on reaction rates. 1964.	Chemistry (BS); Reaction [1MP1]; Rate [1MP2] influenced by Chemistry (BS), Solvent [1P1]	E;213	E,93,11

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
4	ROOK (A). Progress in the biological sciences in relation to dermatology.	Medicine (BS), Skin [1P1] influenced by Biology (BS)	L,87	G
5	SHAW (D T), Ed. Soil physical conditions and plant growth. 1952.	Agriculture (BS), Cultivar [1P1]; Growth [1MP1] influenced by Agriculture (BS); Soil [1MM1]; Physical property [1MP1]	J,OZ;g7	J;1;c
6	JOHNSON (A S). Relation of nutrition to endocrine reproductive functions in the milkwood bug Oncopeltus fasciatus Dallas. 1958.	Zoology (BS), Oncopeltus fasciatus [1P1], Endocrine organ [1P2]; Reproductive function [1MP1] influenced by Zoology (BS), Oncopeltus fasciatus [1P1]; Nutrition [1MP1]	K,83,06;36	K,83,06,53

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
7	NIZEL (A E). Science of nutrition and its application to clinical dentistry. 1967.	Medicine (BS), Tooth [1P1]; Health [1MP1] influenced by Medicine (BS); Nutrition [1MP1]	L,214;5	L;53
8	PRICE (H L) and COHEN (P J), Ed. Effects of anesthetics on the circulation. 1964.	Medicine (BS), Circulatory system [1P1] ; Circulation [1MP1] influenced by Pharmacology (BS), Anesthetic	L,3;3	LX3,17
9	TRUMP (S W), Ed. Medical biometeorology. 1963.	Medicine (BS); Health [1MP1] influenced by Climatography (BS), Climate [1P1]	L;5	U28,7
10	HELLBRIGGE (T) and others. Sleep and wakefulness in the development of the child.	Child medicine (BS); Development [1MP1] influenced by Psychology (BS), Child [1P1] ; Sleep and wakefulness [1MP1]	L9C;7	S,1;31

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
11	HARDY (H C) and HOEFER (C H). Healthy growth. Study of the influence of health education on growth and development of school children. 1936.	Child medicine (BS); Health [1MP1] influenced by Education (BS), School [1P1] ; Curriculum - Hygiene [1MP1]	L9C;5	T,2;2-(L;5)
12	KALTREIDER (D F). Effects of height and weight on pregnancy and the newborn. 1963.	Medicine of new born (BS) influenced by Female medicine (BS), Body [1P1]; Weight [1MP1]	L9C0	L9F,1;c2
13	JODI (E). Heart and sport. 1964.	Sport (BS); Performance [1MP1] influenced by Medicine (BS), Heart [1P1] ; Physiology [1MP1]	MY;3	L,32;3

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
14	WILNER (D M) and others. Human relation in inter-racial housing. 1955.	Town planning (BS), Housing [1P1]. USA [S] influenced by Sociology (BS), USA - Negro [1P1]; Social relation [1MP1]	NB(73-N),3	Y,773.596
15	BENJAMIN (A C). Science, technology, and human values. 1965.	Ethics (BS), Social [1P1]; Value [1MP1] influenced by Natural Sciences (BS); Development [1MP1]	R4,3;7	A:g7
16	BRAIN (R). Contribution of medicine to our idea of the mind. 1965.	Psychology (BS) influenced by Medicine (BS), Nervous system [1P1] ; Physiology [1MP1]	S	L,7;3

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
17	HOGUE (H E). Christian faith and the campus mind. 1965.	Psychology (BS), Student [1P1]; Behaviour [1MP1] influenced by Religion (BS), Christianity [1P1]	S,697;1Z	Q,6
18	GOINS (J T). Visual perceptual abilities and reading progress. 1963.	Psychology (BS); Reading ability [1MP1] influenced by Psychology (BS); Perception [1MP1]	S;687	S;4
19	TORRANCE (E P). Education and the creative potential. 1963.	Psychology (BS); Creativity [1MP1] influenced by Education (BS)	S;737	T

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
20	SIMONS (R D G Ph). Colour of the skin in human relations. 1961.	Social Psychology (BS); Social ethics [1MP1] influenced by Medicine (BS), Skin [1P1]; Colour [1MP1]	S9Y;r43	L,87;c5
21	ABELL (A I). American catholism and social action. 1964.	History (BS), USA [1P1]; Justice [1MP1]; 1868-1950 [T1] influenced by Religion (BS), Roman Catholic [1P1]	V,73;3(Z)'N50	← M68 Q,62
22	RIGGS (R E). Politics in the United Nations: A study of the United States influence in the General Assembly. 1958.	History (BS), United Nations [1P1]; Policy [1MP1] influenced by History (BS), USA [1P1]	V,1N48;1	V,73

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
23	WINDELL (G G). Catholics and German Unity, 1866-1371. 1954.	History (BS), Germany [1P1]; Bismark [1P2]; Policy [1MP1] influenced by Sociology (BS), Germany-Catholics [1P1]	V,55,2Y7;1	Y,755-(Q62)
24	SALTER (W E G). Productivity and technical change.	Economics (BS); Productivity [1MP1] influenced by Natural Sciences	X;a17	A
25	ANDERSON (A), Ed. Education and economic development. 1965.	Economics (BS); Productivity [1MP1] influenced by Education.	X;a17	T
26	HUBBARD (B). Political and economic structures. 1964.	Economics (BS); Structure [1MP1] influenced by Political Science (BS), State [1P1]; Structure [1MP1]	X;2	W,OZ;2

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
27	LAURENTI (L). Property values and race. Studies in seven cities. 1960.	Economics (BS), Property [1P1]; Value [1MP1]. USA [S] influenced by Sociology (BS), USA [1P1] ; Race relation [1MP1]	X,722;x4.73	Y,773;397
28	GADALLA (S M). Land reform in relation to social development, Egypt. 1962.	Economics (BS); Development [1MP1]. Egypt [S] influenced by Law (BS), Egypt [1P1], Land [1P2]	X;7 677	Z,677211
29	MAIZELS (A). Industrial growth and world trade. 1965.	Commerce (BS) influenced by Industrial economics (BS)	X5	XX

SN	Document Reference	Facet Analysis	Class Number	
			Phase 1	Phase 2
30	JOHNSON (D G) and GUSTAFSON (R L). Grain yields and the American food supply. 1962.	Industrial economics (BS), Food [1P1]; Supply [1MP1] influenced by Agriculture (BS), Cereal [1P1]; Yield [1MP1]	XX,(F8,3):3	J,38;7
31	INFLUENCE OF science upon modern culture etc. 1961.	Sociology (BS); Culture [1MP1] influenced by Natural Sciences (BS)	Y;1	A
32	AMES (V M). Zen and American thought. 1962.	Sociology (BS), USA [1P1]; Culture [1MP1] influenced by Religion (BS), Zen Buddhism [1P1]	Y,773;1	Q,4596
33	PESSIN (D). History of the Jews in America. 1958.	Sociology (BS), USA [1P1]; Culture [1MP1] influenced by Sociology (BS), USA-Jew [1P1]	Y,773;1	Y,773-73(Q5)

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b = Bias Relation e = Tool Relation g = Influence Relation

Phase 2	Phase 1										
	z	3v	7	9P5	A	B	B33	B463	B6	B7	BT
8	-	b	-	-	-	-	-	-	-	-	-
A	-	b	-	-	-	-	-	-	-	-	-
B7	-	-	-	-	-	-	-	e	-	-	-
B8	-	-	-	-	-	-	b	-	-	-	-
B8U8	-	-	-	-	-	b	-	-	-	-	-
CZ	-	-	-	-	-	-	-	e	-	-	-
D	-	-	-	-	-	-	b	-	-	b,e	-
D4	-	-	-	-	-	-	-	-	-	-	-
D6	-	-	-	-	-	-	-	-	-	-	-
DYE	-	-	-	-	-	-	-	b	-	-	-
E	-	-	-	-	-	-	-	-	-	-	-
G	-	-	b	-	-	-	-	-	-	-	-
HUB	-	-	-	-	-	-	-	-	b	-	-
J	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	-
L	-	-	b	b	-	--	-	-	-	-	-
L9F	-	-	-	-	-	-	-	-	-	-	-
LT	-	-	-	-	-	-	-	-	-	-	-
LX	-	-	-	-	-	-	-	-	-	-	-
LY1	-	-	-	-	-	-	-	-	-	-	-
LY7	-	-	-	-	-	-	-	-	-	-	-
MD8	-	-	-	-	-	-	-	-	-	-	-
MX8	-	-	-	-	-	b	-	-	-	-	-
Q	-	-	-	-	-	-	-	-	-	-	-
S	-	-	-	-	g	-	-	-	-	-	-
T	-	-	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-
W	-	-	-	-	-	-	-	-	-	-	-
Y	-	-	-	-	-	b	-	-	-	-	b
XX	-	-	-	-	-	-	-	-	-	-	-
Y	-	-	--	-	-	-	-	-	-	-	-
Z	g	-	-	-	-	-	-	-	-	-	-

(Continued)

Phase 2	Phase 1												
	BTT	C	C5	C9B3	E	G	GT	GUE	HUC7	J	K	L	L9C
8	b	-	-	-	-	-	-	-	-	-	-	-	-
A	-	-	-	-	-	-	-	-	-	-	-	-	-
B7	-	-	-	-	-	-	-	-	-	-	-	-	-
B8	-	-	-	-	-	-	-	-	-	-	-	-	-
B8U8	-	-	-	-	-	-	-	-	-	-	-	-	-
CZ	-	-	-	-	-	-	-	-	-	-	-	-	-
D	-	-	-	-	-	-	-	-	-	-	-	-	-
D4	-	-	-	-	c	-	-	-	-	-	-	-	-
D6	-	e	-	-	-	-	-	-	-	-	-	-	-
DYE	-	-	-	-	-	-	-	-	-	-	-	-	-
E	-	-	-	-	g	-	-	-	-	-	-	-	-
G	-	-	-	-	b	-	-	-	-	-	-	b ,e	-
HUB	-	-	-	-	-	-	-	-	-	-	-	-	-
J	-	-	-	-	b	b	-	-	-	g	-	-	-
K	-	-	-	-	-	-	-	-	-	-	g	-	-
L	-	b	b	-	b	-	-	b	-	-	-	b ,g	-
L9F	-	-	-	-	-	-	-	-	-	-	-	-	g
LT	-	-	-	-	-	-	-	-	-	-	-	b	-
LX	-	-	-	b	-	-	-	-	-	-	-	-	-
LY1	-	-	-	-	-	-	b	-	-	-	-	b	-
LY7	-	-	-	-	-	-	-	-	-	-	-	b ,g	-
MD8	-	-	-	-	-	-	-	-	b	-	-	-	-
MX8	-	-	-	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	-	-	-	-	-	-	-	-	-	-
S	-	-	-	-	-	-	-	-	-	-	-	-	g
T	-	-	-	-	-	-	-	-	-	-	-	-	g
U	-	-	-	-	-	-	-	-	-	-	-	g	-
V	-	-	-	-	-	-	-	-	-	-	-	-	-
W	-	-	-	-	-	-	-	-	-	-	-	-	-
Y	-	-	-	-	-	-	-	-	-	-	-	-	-
XX	-	-	-	-	-	-	-	-	-	-	-	-	-
Y	-	-	-	-	-	-	-	-	-	-	-	-	-
Z	-	-	-	-	-	-	-	-	-	-	-	-	-

(Continued)

Phase 2	Phase 1												
	LY7	MY	NB	P	R4	S	S9Y	S9M	V	X	X5	XX	Y
8	-	-	-	-	-	-	-	-	-	-	-	-	-
A	-	-	-	-	g	-	-	-	-	g	-	-	g
B7	-	-	-	-	-	-	-	-	-	-	-	-	-
B8	-	-	-	-	-	-	-	-	-	-	-	-	-
BTU8	-	-	-	-	-	-	-	-	-	-	-	-	-
C2	-	-	-	-	-	-	-	-	-	-	-	-	-
D	-	-	-	-	-	-	-	-	-	-	-	-	-
D4	-	-	-	-	-	-	-	-	-	-	-	-	-
D6	-	-	-	-	-	-	-	-	-	-	-	-	-
DYE	-	-	-	-	-	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-	-	-	-	-
G	-	-	-	-	-	-	-	-	-	-	-	-	-
HUB	-	-	-	-	-	-	-	-	-	-	-	-	-
J	-	-	-	-	-	-	-	-	-	-	-	g	-
K	-	-	-	-	-	-	-	-	-	-	-	-	-
L	b	g	-	b	-	g	g	-	-	-	-	-	-
L9F	-	-	-	-	-	-	-	-	-	-	-	-	-
LT	-	-	-	-	-	-	-	-	-	-	-	-	-
LX	-	-	-	-	-	-	-	-	-	-	-	-	-
LY1	-	-	-	-	-	b	-	-	-	-	-	-	-
LY7	-	-	-	-	-	-	-	-	-	-	-	-	-
MD8	-	-	-	-	-	-	-	-	-	-	-	-	-
MX8	-	-	-	-	-	-	-	-	-	-	-	-	-
Q	-	-	-	-	-	g	-	-	g	-	-	-	g
S	-	-	-	-	-	g	-	-	-	-	-	-	-
T	-	-	-	-	-	b,g	-	b	-	g	-	-	-
U	-	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	g	-	-	-	-
W	-	-	-	-	-	-	-	-	-	g	-	-	-
Y	-	-	-	-	-	-	-	-	-	-	-	-	-
XX	-	-	-	-	-	-	-	-	-	-	g	-	-
Y	-	-	g	-	-	-	-	-	g	g	-	-	g
Z	-	-	-	-	-	-	-	-	-	g	-	-	-

95 Table 4. Examples of Subjects involving the Isolate Idea "Basis"

SN	Document Reference	Facet Analysis	Subject Analysis showing Phase Relation
a	b	c	d
1	MILLER (G A). Psychology of communication. 1968.	Communication (BS); Basis-Psychology [1MP1]	Psychology (BS) bias to Communication (BS)
2	SHANNON (C E) and WEAVER (W). Mathematical theory of communication. 1963.	Communication (BS); Basis-Mathematics [1MP1]	Communication (BS) application of Mathematics (BS)
3	JOAD (C E M). Philosophical aspects of modern science. 1964.	Natural Sciences (BS); Basis-Philosophy [1MP1]	Philosophy (BS) bias to Natural Sciences (BS)
4	CHAPMAN (S) and COWLING (T C). Mathematical theory of non-uniform gases. 1964.	Mechanics (BS), Gas-Non-uniform [1P1]; Dynamics [1MP1]; Basis-Logic [1MP1]	Mechanics (BS), Gas-Non-uniform [1P1]; Dynamics [1MP1] application of Mathematics (BS)

SN	Document Reference	Facet Analysis	Subject Analysis showing Phase Relation
a	b	c	d
5	HACKING (I M). Logic of statistical inference. 1965.	Conclusion theory (BS); Basis-Logic [1MP1]	Logic (BS) bias to Conclusion theory (BS)
6	BUSBRIDGE (I W). Mathematics of radiative transfer. 1965.	Heat (BS); Transfer-Radiation [1MP1] ; Basis-Mathematics [1MP2]	Heat (BS); Transfer-Radiation [1MP1] application of Mathematics (BS)
7	EDDINGTON (A S). Mathematical theory of relativity.	Relativity (BS); Basis-Mathematics [1MP1]	Relativity (BS) application of Mathematics (BS)
8	LUNEBERG (R K). Mathematical theory of optics. 1964.	Electromagnetic radiation (BS), Light [1P1] ; Basis-Mathematics [1MP1]	Electromagnetic radiation (BS), Light [1P1] application of Mathematics [1MP1]
9	HAIGHT (F A). Mathematical theories of traffic flow. 1963.	Transport engineering (BS), Road [1P1]; Movement [1MP1]; Basis-Mathematics [1MP2]	Transport engineering (BS), Road [1P1]; Movement [1MP1] application of Mathematics [1MP2]

SN	Document Reference	Facet Analysis	Facet Analysis showing Phase Relation
a	b	c	d
10	RASHEVSKY (N). Mathematical principles in biology and their applications. 1961.	Biology (BS); Basis-Mathematics [1MP1]	Transport engineering (BS), application of Mathematics (BS)
11	RUTTEN (M G). Geological aspects of the orgin of life on earth. 1962.	Biology (BS), Life [1P1] ; Basis-Geology [1MP2]	Biology (BS), Life [1P1]; Origin [1MP1] influenced by Geology (BS)
12	JOKI (E). Medical sociology and anthropology of sports and physical education. 1964.	Sports (BS); Performance [1MP1] ; Basis-Anthropology [1MP2]	Sports (BS); Performance [1MP1] in relation to Anthropology (BS)
13	WOODGER (J H). Biology and language. 1964.	Linguistics (BS); Basis-Biology [1MP1]	Linguistics (BS) influenced by Biology (BS)

SN	Document Reference	Facet Analysis	Subject Analysis showing Phase Relation
a	b	c	d
14	THOULESS (R H). Introduction to the psychology of religion.	Religion (BS); Basis-Psychology [1MP1]	Religion (BS) application of Psychology (BS).
15	ZUURDEEG (W F). Analytical philosophy of religion. 1965.	Religion (BS), Christianity [1P1] ; Basis-Philosophy [1MP1]	Religion (BS), Christianity [1P1] application of Philosophy (BS)
16	SEN (A K). Development planning and economic theory. 1966.	Economics (BS), Christianity [1P1]; Development [1MP1] ; Plan [1MP2] ; Basis-Economics [1MP3]	Economics (BS), Resource [1P1]; Development [1MP1]; Plan [1MP2] application of Economics (BS)

SN	Document Reference	Facet Analysis	Subject Analysis showing Phase Relation
a	b	c	d
17	COMMONS (J R). Legal foundations of capitalism. 1959.	Capitalistic economy (BS); Basis-Law [1MP1]	Capitalistic economy (BS), application of Law (BS)
18	DOBZHANSKY (T). Biological basis of human freedom. 1956.	Psychology (BS); Freedom [1MP1] ; Basis-Biology	Psychology (BS); Freedom [1MP1] in relation to Biology (BS) .
19	GREENFIELD (N S) and LEWIS (W C), Ed. Psychoanalysis and current biological thought. 1965.	Psychoanalysis (BS); Behaviour [1MP1] ; Basis-Biology [1MP2]	Psychoanalysis (BS); Behaviour [1MP1] in relation to Biology [1MP2]
20	CAMPENELLIE (T C). Psychology of education. 1960.	Education (BS); Basis-Psychology [1MP1]	Psychology (BS) bias to Education (BS) .

SN	Document Reference	Facet Analysis	Subject Analysis showing Phase Relation
a	b	c	d
21	McDONALD (F). We the people. Economic origins of the constitution. 1958.	History (BS), USA [1P1] ; Constitution [1MP1]; Basis-Economics [1MP2]	History (BS), USA [1P1]; Constitution [1MP1] in relation to Economics (BS).
22	HALLOWELL (J H). Moral foundation of democracy. 1954.	Political Science (BS), Democracy [1P1] ; Basis-Ethics [1MP1]	Political Science (BS), Democracy [1P1] : Evaluation [1E](from the angle of Ethics)
23	SAMUELSON (P A). Foundations of economics.	Economics (BS); Basis-Mathematics [1MP1]	Economics (BS) application of Mathematics (BS)

96 Table 5. Examples of Subjects involving the Isolate Idea "Interpretation"

SN	Document Reference	Facet Analysis	Subject Analysis showing 'Evaluation' Relation
a	b	c	d
1	JORAVSKY (D). Soviet Marxism and natural science, 1917-1932. 1961.	Natural Sciences (BS); Interpretation - Marxism Soviet [1MP1] '1932 ← 1917 [T1]	Natural Sciences (BS); Evaluation [1E] (from the angle of Soviet Marxism) '1932 ← 1917 [T1]
2	SMETHURST (A F). Modern science and Christian beliefs. 1965.	Natural Sciences (BS); Interpretation - Christianity [1MP1]	Natural Sciences (BS): Evaluation [1E] (from the angle of Christianity)
3	STRUNK (O)(Jr). Religion: Psychological interpretation. 1965.	Religion (BS); Interpretation - Psychology [1MP1]	Religion (BS): Evaluation [1E] (from the angle of Psychology).
4	LEVNITHAL (I M). Judaism speaks to the modern world. 1963.	Ethics (BS), Social [1P1]; Interpretation - Judaism [1MP1]	Ethics (BS), Social [1P1]; Evaluation (from the angle Judaism)

SN	Document Reference	Facet Analysis	Subject Analysis showing 'Evaluation' Relation
a	b	c	d
5	BAXTER (K M). Contemporary theatre and the Christian faith. 1965.	Ethics (BS), Theatre [1P1]; Interpretation - Christianity [1MP1]	Ethics (BS), Theatre [1P1]; Interpretation - Christianity [1MP1]
6	BAINTON (R H). Chrisian attitudes towards war and peace. 1965.	Ethics (BS), State [1P1]; Policy - War and peace [1MP1] ; Interpretation-Christianity [1MP2]	Ethics (BS), State [1P1]; Policy - War and peace [1MP1] : Evaluation [1E] (from the angle of Christianity)
7	WALLRAFF (C F). Philosophical theory and psychological fact : Attempt at synthesis. 1961. [Epistemological interpretation of cognition]	Psychology (BS); Cognition [1MP1]: Interpretation - Epistemology [1MP2]	Psychology (BS); Cognition [1MP1] : Evaluation [1E] (from the angle of Epistemology)

SN	Document Reference	Facet Analysis	Subject Analysis showing 'Evaluation' Relation
a	b	c	d
8	SELIGMAN (E R H). Economic interpretation of history. 1961	History (BS); Interpretation - Economics [1MP2]	History (BS): Evaluation [1E] (from the angle of Economics)
9	PHILLIPS (J E). Images of a Queen: Mary Stuart in sixteenth century literature. 1964.	History (BS), Great Britain [1P1], Queen Mary Stuart [1P2]; Representation - English literature [1MP1] 'Sixteenth century [T1]	Literature (BS), English [1P1]: Evaluation [1E] (from the angle of History (BS), Great Britain [1P1], Queen Mary Stuart [1P2]
10	BROWN (E E). French revolution and the American men of letters. 1951.	History (BS), France [1P1] ; Struggle for independence [1MP1]; Interpretation - American literature [1MP2]	Literature (BS), English - USA [1P1] : Evaluation [1E] (from the angle of History (BS), France [1P1]; Struggle for independence [1MP1]

SN	Document Reference	Facet Analysis	Subject Analysis showing 'Evaluation' Relation
a	b	c	d
11	HORDERN (W). Christianity and Communism. 1965.	Political Science (BS), Communism [1P1]; Interpretation - Christianity [1MP1]	Political Science (BS), Communism [1P1] : Evaluation [1E] (from the angle of Christianity)
12	MILLER (H M). Christian critique of culture. 1965.	Sociology (BS), USA [1P1]; Culture [1MP1] ; Interpretation - Christianity [1MP2]	Sociology (BS), USA [1P1]; Culture [1MP1]: Evaluation [1E] (from the angle of Christianity)
13	BARRON (J D). Alcohol problem in the light of the Bible. 1965.	Sociology (BS), USA [1P1]; Alcoholism [1MP1]; Interpretation - Christianity [1MP2]	Sociology (BS), USA [1P1]; Alcoholism [1MP1] : Evaluation [1E] (from the angle of Christianity)
14	TILSON (E). Segregation and the Bible. 1965.	Sociology (BS), USA [1P1]; Segragation [1MP1] ; Interpretation - Christianity [1MP2]	Sociology (BS), USA [1P1]; Segregation [1MP1] : Evaluation [1E] (from the angle of Christianity)

97 Table 6. Subjects involving "Method"

SN	Document Reference	Facet Analysis
a	b	c
1	MORSE (P M). Library effectiveness. A system approach. 1968.	Library Science (BS), Library [1P1] ; Operation [1MP1] : Analysis [E] , Statistical method [2P1]
2	VARDAMAN (G T) and HALTERMAN (C C). Management control through communication. 1968.	Management (BS); Operations [1MP1] ; Control-Communication [1MP2]
3	ALT (F L). Electronic digital computers. Their uses in science and engineering. 1958.	Natural Science (BS); Data [1MP1]: Computation [1E], Electronic digital computer [2P1]
4	BISHOP (R E D) and others. Matrix analysis of vibrations. 1965.	Mechanics (BS); Vibration [1MP1]: Analysis [1E], Matrix algebra [2P1]
5	JAWSON (M A). Introduction to mathematical crystallography. 1965.	Properties of Matter (BS), Crystal [1P1]; Structure [1MP1] : Analysis [1E], Group theory [2P1]
6	FOWLER (R H) and GUGGENHEIM (E A). Statistical thermodynamics. 1965.	Heat (BS), Thermodynamics [1MP1]: Analysis [1E], Statistical method [2P1]

SN	Document Reference	Facet Analysis
a	b	c
7	WIGNER (E P). Group theory and its application to the quantum mechanics of atomic spectra. 1959.	Quantum theory - Elementary particle physics (BS), Particle [1P1] ; Spectrum [1MP1] : Analysis [1E] , Group theory [2P1]
8	INGLIS (C E). Mathematical treatise on vibrations in railway bridges. 1965.	Track engineering (BS). Bridge - Railway [1P1] ; Vibration [1MP1] : Analysis [1E] , Mathematical Method
9	CLARK (M)(Jr). Numerical methods of reactor analysis. 1964.	Commodity production engineering (BS), Reactor vessel [1P1] ; Design [1MP1] : Analysis [1E] , Numerical method [2P1]
10	ARIS (R). Optional design of chemical reactors: study in dynamic programming. 1961.	Commodity production engineering (BS), Reactor vessel - Chemical [1P1] ; Design [1MP1] : Optimum [1MP2] : Computation [1E] , Dynamic programming [2P1]

SN	Document Reference	Facet Analysis
a	b	c
11	JENSON (V G) and JEFFREYS (G V). Mathematical methods in chemical engineering. 1963.	Chemical engineering (BS), Process [1P1] ; Variable [1MP1]: Measurement [1E] , Mathematical method [2P1]
12	VATERMAN (H I) and others. Process characterisation. Graphical statistical methods of product distribution and physical operations.	Production technology (BS), Commodity [1P1]; Distribution [1MP1] : Analysis [1E], Statistical method [2P1]
13	FINNEY (D J). Statistical method in biological essay. Ed 2. 1964.	Biology (BS); Constituents [1MP1]: Determination [1E], Statistical method [2P1]
14	GREENWOOD (M). Medical statistics. 1965.	Medicine (BS); Data [1MP1] : Analysis [1E], Statistical method [2P1]
15	ADKINS (D C) and LVERLY (S B). Factor analysis of reasoning tests. 1952.	Psychology (BS); Reasoning capacity [1MP1] : Measurement [1E] ; Data [2MP1] : Analysis [2E], Factor analysis [3P1]
16	PIAGET (J). Logic and psychology. 1957.	Psychology (BS), Child [1P1]; Intellect [1MP1]; Development [2P]

SN	Document Reference	Facet Analysis
a	b	c
17	DIAMON (S). Information and error. 1959.	Psychology (BS); Information-gathering behaviour [1MP1]; Error [1MP2]; Incidence [1MP3] : Analysis [1E] , Statistical method [2P1]
18	WERT (J E) and others. Statistical methods in educational and psychological research. 1965.	Education (BS); Data [1MP1] : Analysis [1E], Statistical method [2P1]
19	KLEIN (L R). Introduction to econometrics. 1960.	Economics (BS); Data [1MP1]: Analysis [1E], Statistical method [2P1]
20	KALDOR (N) and SILVERMAN. Statistical analysis of advertising expenditure, etc. 1965	Economics (BS). Advertising business [1P1]; Expenditure [1MP1] : Analysis [1E], Statistical method [2P1]
21	McMILLEN (W). Statistical methods for social workers. 1952.	Social work (BS); Data [1MP1]: Analysis [1E], Statistical method [2P1]

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ENERGY ISOLATE AND PROPERTY ISOLATE: PROBLEMS IN DIFFERENTIATION.

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The problems in deeming an action-associated isolate idea as an Energy Isolate and in differentiating a Matter Property Isolate from an Energy Isolate in some cases are mentioned. If the manifestation of an action-associated isolate idea is considered in the total subject-context in which it occurs, there is a possibility of each and every one of such isolates being deemed a Property Isolate. Such a procedure is unhelpful. An approach to a solution of the problems on the basis of a consideration of the definition of "Property" and the way in which Property Isolates are generated in the design of a scheme for classification of the subjects going with a particular Basic Subject, is discussed.

Abbreviations Used:

(BS) = Basic Subject

(FC) = Fundamental Category

Note.- The discussions in this paper are essentially based on S R Ranganathan's Theory of Library Classification and the Colon Classification.

1 POSTULATE OF FUNDAMENTAL CATEGORIES

The Postulate of Fundamental Categories states that "There are five and only five Fundamental Categories -- namely, Personality, Matter, Space, and Time (5). Each isolate idea is deemed to be a manifestation of one and only one of the five (FC). The denotation of an isolate idea is to be considered in the subject-context in which it occurs. The determination of the manifestation of an isolate is helped by using the 'Neti-Neti Principle' (Not-This, Not-This Principle).

2 ENERGY ISOLATE

Usually, an isolate idea denoting "action qua action" would be deemed a manifestation of the (FC) Energy. Till about 1967, however, schedules of Energy Isolates in CC contained not only isolates denoting "action qua action", but also isolates denoting other kinds of ideas. This topic has been dealt with in another paper (2).

3 PROPERTY ISOLATE

With the formulation of the concept of Property Isolate and deeming such an isolate as a manifestation of the (FC) Matter (6), it was realised that some of the isolates earlier enumerated in the schedules of Energy Isolates in CC could be deemed as manifestation of the (FC) Matter (Property).

4 PROBLEM

41 Action-Associated Isolate

The re-designation of some of the isolates enumerated in the schedules of Energy Isolates as Property Isolates, raises problems in determining whether an isolate idea associated with an action is to be deemed a manifestation of Energy or of Matter (Property).

42 Examples

Consider the subjects mentioned in Col (b) and the corresponding Isolate Ideas mentioned in Col (d) of the following table:

421 Table 1. Kernel Ideas associated with action

SN	Subject	(BS)	Isolate Idea
a	b	c	d
GROUP A			
1	Circulation of books in a college library.	Library Science	Circulation
2	Physiology of human legs	Medicine	Physiology
3	Christian religious practices	Religion	Practice
4	Delegation of authority by top management	Management Science	Delegation
5	Functions of the President of India	History	Function
6	Naming-ceremony among certain Polynesian communities	Sociology	Naming-ceremony
GROUP B			
1	Measuring the velocity of light	Physics	Measuring
2	Analysis of amino-acids in insulin	Chemistry	Analysis
3	Treatment of the diseases of human heart	Medicine	Treatment
4	Determination of the IQ of primary school children	Psychology	Determination
5	Election of the President of India	History	Election
6	Controlling alcoholism among middle class family	Sociology	Control

Each of the isolates mentioned in Col (d) of Table 1 suggests some kind of action; at any rate, it has the flavour of an action. It is in deciding whether each of these isolates should be deemed as manifestation of Energy or of Matter (Property) that difficulty arises. No such difficulty arises in respect of the ideas mentioned in Col (d) in Group B. Each of them obviously denotes an "action _qua_ action". On the other hand, each of the isolates mentioned in Col (d) in Group A do not appear to denote an "action _qua_ action" with equal certitude.

5 APPROACH TO A SOLUTION

51 Earlier Suggestion

It was earlier suggested (3) that we may consider Property Isolates as falling into two broad categories:

1 Isolate Idea denoting a "static" attribute of an entity or system. For example, "Structure", "Colour", and "Volume"; and

2 Isolate Idea denoting a "dynamic" attribute -- that is, an action-associated attribute denoting some characteristic function -- general or specific -- or a behaviour of an entity or a system. For example, "Function", "Physiology", and "Practice".

52 Application of Criteria

On the basis of the criteria mentioned in Sec 51, it is not difficult to recognise that each of the isolate ideas mentioned in Col (d) in the subjects in Group A in Table 1 denotes a function -- general or specific -- or a characteristic behaviour, of one or the other of the ideas denoted by a component of the corresponding subject mentioned in Col (b). For example, the idea denoted by "Circulation" can be considered as one of the functions of a library or library system. The idea denoted by "Physiology" denotes a characteristic behaviour or mode of functioning of the "human leg". The application of the criteria may not, however, give an unequivocal decision in regard to the isolates mentioned in Col (d) in the subjects in Group B in Table 1. For instance, the idea denoted by "Measuring" cannot conveniently be taken to denote a function -- general or specific -- or a characteristic behaviour, of an idea denoted by any of the component isolates of the corresponding subject "Measuring the velocity of light" mentioned in Col (b). Similarly, the idea denoted by "Treatment" cannot conveniently be taken to denote a function -- general or specific -- or a characteristic behaviour, of an idea denoted by any of the component isolates of the corresponding subject "Treatment of the diseases of human heart". On this basis, one may conclude that such an action-associated isolate may be deemed a manifestation of the (FC) Energy, if it is not to be deemed in the context to be a manifestation of Time, or Space, or Matter (Material), or Personality.

53 Total Subject-Context

However, instead of considering an isolate idea (mentioned in col (d) in subjects of Group B in Table 1 in relation to the idea denoted by any one of the component isolates in the compound subject concerned, we may consider it in relation to the total subject-context involved. For example, let us consider the idea denoted by the isolate "Treatment" in relation to the totality of the ideas going with the subject "Medicine". In that case, one may consider "Treatment" (of disease) as denoting one of the "functions" in the practice of Medicine. Similarly, "Determination" (of IQ) as denoting one of the functions in the practice of "Psychology". Thus, each of these isolate ideas deemed to denote a "function" could be taken to be an attribute in the respective subject-contexts. This leads to such an isolate being deemed as a manifestation of Matter (Property). Thus we have a problem in getting an unequivocal decision by applying the criteria mentioned in Sec 51. For, it appears that the decisions can be different depending upon whether we consider the isolate in relation to the total subject-context or only in relation to one or other of the isolate components of the subject. When considered in the total subject-context, we have another problem. If each and every action-associated isolate idea is considered in relation to the total subject-context, it could lead at least in theory, to deeming every such action-associated idea as a Property Isolate in the respective subject-context concerned. The result may be a classification model according to which a subject would consist of a (BS) and isolates deemed to be manifestation of one of four (FC) only -- P, M, S, and T! We cannot now decide whether this model will be more, or at least, equally helpful as the current model using the concept of five (FC), P, M, E, S, and T. The differentiation between a Property Isolate and an Energy Isolate is further discussed in the succeeding sections.

6 PROPERTY ISOLATES IN A SUBJECT

A solution to the problem mentioned in Sec 53 may be worked out by taking into account the implications of the definition of "Property" and the manner in which Property Isolates are generated in the process of designing and developing the schedules of a scheme for classification of subjects going with a particular (BS).

61 Definition of "Property"

A Property is an attribute common to all members of a class of entities (Webster). Thus, a property can be thought of only in terms of or in relation to an entity.

62 Selection of Property Isolates

The usual steps in the practical methodology to select the isolates to form the different schedules of a scheme for classification are as follows:-

1 Collection and listing of Kernel Ideas likely to occur in the compound subjects going with the particular (BS) under consideration.

Annotation.- The methodology for the selection of the Kernel Ideas on the basis of scanning of macro and micro documents and the listing of these Kernel Ideas on standard 5" x 3" slips together with the definition, indicating whether it is an isolate or a qualifier; indication of the (FC) of which the isolate may be deemed to be a manifestation, etc have been described earlier (1,4).

2 Sorting out the Isolates from the Qualifiers.

Annotation.- In the succeeding steps, we shall deal with the further sorting among the isolates only.

These steps alone are relevant to the discussion in this paper.

3 Sorting out isolates deemed to be a manifestation of the (FC) Time.

4 Sorting out isolates deemed to be a manifestation of (FC) Space.

5 Sorting out isolates deemed to be a manifestation of the (FC) Personality.

6 Sorting out the isolates denoting an attribute of some or all of the Personality Isolates sorted out in Step 5.

Annotation.- An isolate of this kind may denote a static attribute, such as "structure" and "colour", or a dynamic attribute, such as "function", "growth", and "physiology". Each of these isolates would be deemed to be a manifestation of the (FC) Matter -- that is, Matter (Property).

7 Sorting out isolates denoting Matter *qua* Matter. These would be deemed to be a manifestation of (FC) Matter -- that is, Matter (Material).

8 Sorting out isolates denoting an attribute of some or all of the Matter -Material isolates sorted out in Step 7.

Annotation.- An isolate of this kind may denote a static attribute, such as "weight" and "constitution", or a dynamic attribute, such as "evaporation" and "decay". Each of these isolates would be deemed to be a manifestation of the (FC) Matter -- that is, Matter (Property).

9 Sorting out isolates denoting an attribute of some or all of the Matter-Property isolates sorted

out in Steps 6 and 8.

Annotation.- If "colour" is a Property Isolate derived at Step 6, then "intensity" may be an attribute of "colour". These isolates denoting attributes will also be deemed to be a manifestation of the (FC) Matter -- that is, Matter (Property).

10 From the residual isolates, sorting out isolates which cannot be deemed as manifestation of either of the (FC) Personality or Matter (Material) or of Space or of Time and also cannot be deemed as an attribute of any one of these isolate ideas. Each of such isolates would be deemed to be a manifestation of the (FC) Energy.

11 The residual isolates, if any, will be attributes of some or all of the Energy Isolates sorted out in Step 10.

Annotation.- If "treatment" is an Energy Isolate, derived at Step 10, then "effectiveness" may be deemed an attribute of "treatment".

63 Differentiation

From the series of steps for the construction of the different schedules for the scheme for classification of subjects going with a particular (BS) enumerated above, it can be seen that a Property Isolate can only be an attribute possessed or exhibited by some or all of the other species of isolates -- Personality, Matter (Material), Matter (Property), and Energy Isolates -- occurring in the compound subjects going with the (BS) under consideration. In other words, the idea of Property can be thought of only in relation to another isolate idea or sometimes in relation to the (BS), when no particular isolate is mentioned but the account of the (BS) is general and comprehensive. This gives us the idea that in examining whether an action-associated isolate idea occurring in a specific subject going with a particular (BS) is a Property Isolate, we should consider whether it is an attribute of one or the other of the isolate ideas included in the schedule of isolates, of the scheme for classification of the compound subjects going with the (BS) under consideration. If it is not an attribute of any of the isolates included in these schedules, then it can be deemed to be only as an Energy Isolate. An unequivocal decision can be arrived at and the eventuality of having no Energy Isolates at all (See Sec 53) will not arise. It is not, therefore, helpful to consider the manifestation of an action-associated isolate idea in the total subject-context in which it occurs.

64 Review of Examples

Let us reexamine the manifestation of some of the isolate ideas enumerated in Col (d) in the subjects in Group B in Table 1 in Sec 421, in the light of the discussions in Sec 61 to 63.

641 Isolate: "Measuring"

The compound subject "Measuring the velocity of light" goes with the (BS) Radiation Physics. Consider the idea denoted by "Measuring" in relation to the isolates occurring in the CC schedules for the compound subjects going with the (BS) Radiation Physics. "Measuring" cannot be deemed to be an attribute of the idea denoted by the isolate "Light" -- a typical isolate idea in the schedule of Personality Isolates for Radiation Physics. It cannot also be deemed to be an attribute of the idea denoted by "Velocity" -- a typical isolate idea in the schedule of Matter (Property) isolates for the compound subjects going with the (BS) Radiation Physics. The isolate idea denoted by "Measuring" can be similarly considered in relation to each of the isolates enumerated in the schedules of Personality Isolates and of Matter (Property) Isolates given in CC for a compound subject going with the (BS) Radiation Physics. The result leads to the conclusion that "Measuring" is an Energy Isolate.

642 Isolate: "Analysis"

The subject "Analysis of the protein content of insulin" is deemed to go with the (BS) Chemistry. Consider the idea denoted by "Analysis" in relation to the isolates occurring in the CC schedules for the compound subjects going with the (BS) Chemistry. "Analysis" cannot be deemed to be an attribute of the idea denoted by the isolate "Protein" -- a typical isolate idea in the schedule of Matter (Material) isolates for the compound subjects going with the (BS) Chemistry. It cannot also be deemed to be an attribute of the idea denoted by the isolate "Insulin" -- a typical isolate idea in the schedule of Personality isolates for the compound subjects going with the (BS) Chemistry. Again, it cannot also be deemed as an attribute of the idea denoted by the isolate "content" -- a possible typical isolate idea in the schedule for Matter (Property) for the compound subjects going with the (BS) Chemistry. The isolate idea denoted by "Analysis" can be similarly considered in relation to each of the isolates enumerated in the schedule of Personality isolates, Matter (Material) isolates and Matter (Property) isolates in CC for the compound subjects going with the (BS) Chemistry. The result leads to the conclusion that "Analysis" is an Energy isolate.

643 Isolate: "Treatment"

The subject "Treatment of the diseases of human heart" is deemed to go with the (BS) Medicine. Consider the idea denoted by "Treatment" in relation to the isolates occurring in the CC schedules of the compound subjects going with the (BS) Medicine. "Treatment" cannot be deemed to be an attribute of the idea denoted by the isolate "Heart" -- a typical isolate in the schedule of Personality isolates for the compound subjects going with the (BS) Medicine. It cannot also be deemed to be an attribute of the idea denoted by "Disease" -- a typical isolate from the schedule of Matter (Property) isolates for the compound subjects going with the (BS) Medicine. The isolate idea denoted by "Treatment" can be similarly considered in relation to each of the isolates enumerated in the schedules of Personality Isolates and of Matter (Property) isolates in CC for the compound subjects going with the (BS) Medicine. The result leads to the conclusion that "Treatment" is an Energy Isolate.

Following a similar line of argument, it can be shown that the other isolates "Determination", "Election", and "Control" mentioned in Col (d) of the subjects in Group B in Table 1 in Sec 421 are also Energy Isolates in the respective schedules for the compound subjects going with the (BS) Psychology, History, and Sociology.

7 KERNEL IDEAS FOLLOWING ENERGY ISOLATE

71 Attributes of Energy Isolate

We may now consider examples of Kernel Ideas likely to follow an Energy Isolate and how they may be treated in the facet analysis of the subject in which they occur. It will be helpful at this stage to recall to mind some of the postulated attributes of Energy Isolate. These are:-

1 An Energy Isolate may end one Round and start another -- that is, recurrence of Personality and Matter Isolates; and

2 The concept of Level is not applicable to an Energy Isolate.

72 Examples

721 Example 1

Consider the subject

"Intermittent treatment of diseases of human heart".

The Kernel Ideas are:

Medicine. Heart. Disease. Treatment. Intermittent.

1 By Facet Analysis, using the criteria regarding Energy Isolate discussed in Sec 6 and its subdivisions, the first four Kernel Ideas may be labelled as follows:

Medicine (BS). Heart [1P1]. Disease [1MP1].
Treatment [1E].

The idea denoted by "Intermittent" is associated with the idea of the manner in which the treatment is applied. Therefore, this hidden idea or ellipsis "Application" should be explicitly brought out as a Kernel Idea. Thus, the subject mentioned at the beginning of this Section will have the following Kernel Ideas arranged according to the appropriate Principles for Helpful Sequence.

Medicine (BS). Heart [1P1]. Disease [1MP1]
Treatment [1E]. Application. Intermittent.

Here, "Application" is an expression or an evidence of the "Treatment". Hence, in relation to "Treatment" with which it is most closely associated in the subject under consideration, "Application" would be deemed to be an attribute of "Treatment". Hence, it would be deemed to be a manifestation of the (FC) Matter -- that is, it will be a Matter-Property Isolate.

Next, "Intermittent" denotes the manner of application -- specifically the "frequency" in the present case. Therefore, "Intermittent" will be deemed to be a Qualifier to "Application". The components of the subject can now be arranged and labelled as follows:

Medicine (BS), Heart [1P1]; Disease [1MP1] :
Treatment [1E]; Application-Intermittent [2MP1]

2 Another way of facet analysing the subject may be as follows:

Medicine (BS), Heart [1P1]. Disease [1MP1] :
Treatment [1E]; Intermittent [2MP1]

Here, "Application" has been dropped as if it were a puff; and "Intermittent" is deemed to be a Matter-Property isolate. "Intermittent" can, of course, occur as an attribute of the Energy isolate "Treatment". A preferable term would then be "Intermittancy". But this facet-analysis would more appropriately represent a subject such as:

"Intermittancy in the treatment of heart disease". In the subject under consideration, "Intermittant" is a Qualifier to "Treatment". But the direct attachment of a Qualifier to an Energy isolate is not yet admitted.

722 Example 2

Consider the subject:

"Streptomycin treatment of tuberculosis of the lungs at dosage levels of once in three days for one month".

The Kernel Ideas are:

Streptomycin. Treatment. Tuberculosis. Lungs. Once in three days. One month. Medicine.

1 Facet analysis would give:
Medicine (BS), Lung [1P1]; Tuberculosis [1MP1]: Treatment [1E]; Application-Streptomycin-Once in three days-One month [2MP1].

Here, the Kernel Ideas "Streptomycin" (the drug given) "Once in 3 days" (the dosage), and "one month" (the period of treatment), each denotes a manner of application of the treatment. Each of them is, therefore, a Qualifier to "Application".

2 A second way of facet analysing the subject may be as follows:
Medicine (BS); Lung [1P1]; Tuberculosis [1MP1]: Treatment [1E], Streptomycin [2P1]: Application [2E]; Once in 3 days [3MP1]; One month [3MP2].

Here, all the Kernel Ideas are represented and they may be said to be arranged in a helpful sequence also.

However, the Kernel Ideas "Once in 3 days" and "One month" denote the "mode of application of the treatment" in the subject under consideration. In other words, they should preferably be treated as Qualifiers to the isolate "Application". But the latter isolate is deemed to be a manifestation of Energy. The direct attachment of a Qualifier to an Energy Isolate is still under consideration. The facet analysis given above would perhaps more appropriately represent a subject such as the following:

> Consideration of once-in-three day-frequency for one month, in the streptomycin treatment of tuberculosis of lungs.

3 A third way of facet analysing the subject may be as follows:

Medicine (BS), Lung [1P1]; Tuberculosis [1MP1]: Treatment [1E], Streptomycin [1P2]; Once in three days [2MP1]; One month [2MP2]

The difference between the facet-analysis in 2 and 3 is that in 3 the Kernel Idea "Application" is omitted. Here again, the argument is that the Kernel Ideas "Once in 3 days" and "One month" denote the manner of application of treatment. Therefore, each should preferably be deemed to be a Qualifier and not a Property qua Property Isolate.

4 A fourth way of facet-analysing the subject may be as follows:

Medicine (BS). Lung [1P1]; Tuberculosis [1MP1]: Treatment [1E]; Streptomycin [2MM1]: Once in 3 days [2MP2]; One month [2MP3].

The difference between the facet analysis in 3 and 4 is that in 4 "Streptomycin" to be a manifestation of Matter-Material, whereas in 3, it is deemed to be a manifestation of Personality. The rest of the arguments given under 3 holds good here also.

723 Example 3

Consider the subject

"Exercise of control by top management through organisational structuring".

The Kernel Ideas are:

Control. Top Management. Organisational Structuring. Management science.

'Exercise' is considered to be a puff and therefore dropped in selecting the Kernel Ideas.

1 Facet analysis would give

Management science (BS), Top management [1P1]; Control-Organisational structuring [1MP1].

Here, "Control" denotes a function of "Top management". Therefore, it is a Property Isolate. "Organisational structuring" denotes a method of exercising control. Therefore, it is a Qualifier to the Property Isolate "Control".

2 Another way of facet analysing the subject may be as follows:

Management science (BS), Top management [1P1]; Control [1MP1]; Organisational structuring [1MP2].

Here, "Organisational structuring" is taken to be a Property Isolate and not as a Qualifier of "Control". The subject representation according to this facet analysis may also be taken to denote

"Organisational structuring of the control."

This subject will not be fully coextensive with the subject under consideration.

724 Example 4

Consider the subject

"Legislative measures for the control of alcoholism among juveniles".

The Kernel Ideas are:

Legislative measure. Control. Alcoholism. Youth. Sociology.

Facet analysis would give:

Sociology (BS), Youth [1P1]; Alcoholism [1MP1]:Control [1E], Legislative measure [2P1].

Can we take "Legislative measure" as an attribute of "Control"? It may not be expedient to do so with respect to the subject under consideration. On the other hand, in a subject such as

"Law relating to alcoholism among juveniles"

the facet analysis could be

Sociology (BS), Youth [1P1]; Alcoholism [1MP1]; Law [2MP1].

Here, "Law" does not denote a particular method of "Control" of alcoholism, unlike the case of "Legislative measure" mentioned earlier.

8 FREELY-FACETED CLASSIFICATION

It is worth noting that one and the same Isolate Idea may be deemed to be a manifestation of different (FC). For example, "Control" is deemed to be a manifestation of Energy in the subject in Example 4, whereas it is deemed to be a manifestation of Matter (Property) in the subject in Example 3. This is so because in Example 4, "Control" cannot be considered as an attribute of either of the Personality Isolate "Youth" or of the Matter (Property) Isolate "Alcoholism". In Example 3, on the other hand, "Control" can be considered as a function of "Top management" and therefore is deemed to be a Property Isolate. Such differentiated treatment of a Kernel Idea in different subject-contexts is in conformity with the theory of Freely-Faceted Classification.

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A PROBLEM IN FACET SEQUENCE IN CC.

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In some subjects, the sequence of facets helpful to the majority of specialist readers may not conform to the Postulate of Decreasing Concreteness, Postulate of Level Cluster, and the Postulate about Levels in Matter Facet. Different approaches to a solution of the problem are examined. A sequence of kernel ideas in subjects going with a particular Basic Subject helpful to the majority of readers can be derived with the aid of the Wall-Picture Principle and its corollaries, but without considering a "Property" as an isolate. This can also result in increased Hospitality among Facets.

Abbreviations Used:

(BS) = Basic Subject

[E] = Energy Facet

[MM] = Matter (Material) Facet

[MP] = Matter (Property) Facet

[P] = Personality Facet

1 SUBJECTS FOR CONSIDERATION

Consider the subjects of the documents mentioned in Sec 11 to 13. The facet analysis of each subject according to the Method of Postulates (4) is also given.

11 Example 1

Document: Detection of particles entrained in seeds and blisters in glass.

Step 0. Raw Title Detection of particles entrained in seeds and blisters in glass.

Step 1.	Expressive Title	In Production technology, detection of presence of entrained particles in seed and blister defect in glass.
Step 2.	Kernel Title	Production technology. Detection. Presence. Entrained particle. Seed and blister defect. Glass.
Step 3.	Analysed Title	Production technology (BS). Detection [1E]. Presence [2MP1]. Particle-Entrained [1MM1]. Seed and blister defect [1MP1]. Glass [1P1].
Step 4.	Transformed Title	Production technology (BS). Glass [1P1]. Seed and blister defect [1MP1]. Particle-Entrained [1MM1]. Presence [1MP2]. Detection [1E].
Step 5.	Title in standard terms with Indicator Digits	Chemical Production technology (BS), Glass [1P1]; Seed and blister defect [1MP1]; Particle-Entrained [1MM1]; Existence [1MP2]: Detection [1E].

12 Example 2

Document: SILIQUINI (P L) and others. Contribution to the study of the serum protein pattern in patients with fractures. Observations on 20 cases (Minerva ortop. 18;1967;201-6).

Step 0.	Raw Title	Contribution to the study of the serum protein pattern in patients with fractures.
Step 1.	Expressive Title	In Medicine, Variation of serum protein pattern in patients with bone fracture defect.
Step 2.	Kernel Title	Medicine. Variation. Serum protein. Pattern. Bone. Defect-Fracture.
Step 3.	Analysed Title	Medicine (BS). Variation [1MP3] Serum protein [1MM1]. Pattern [1MP1]. Bone [1P1]. Defect-Fracture [1MP2].
Step 4.	Transformed Title	Medicine (BS). Bone [1P1]. Defect-Fracture [1MP1]. Serum protein [1MM1]. Pattern [1MP2]. Variation [1MP3].
Step 5	Title in standard term with Indicator Digits	Medicine (BS), Bone [1P1]; Defect-Fracture [1MP1]; Serum protein [1MM1]; Pattern [1MP2] ; Variation [1MP3].

13 Example 3

Document: KONDO (T). Bone marrow fatty acid composition in children with hematological disease and after adrenocorticoid administration. (Acta paediat Jap. 71;1967; 1620-4).

Step 0.	Raw Title	Bone marrow fatty acid composition in children with hematological disease. [This is one subject of the document].
Step 1.	Expressive Title	In child medicine, Bone marrow fatty acid composition in children with hematological disease.
Step 2.	Kernel Title	Child medicine. Fatty acid. Bone marrow. Composition. Blood. Disease.
Step 3.	Analysed Title	Child medicine (BS). Fatty acid - Bone marrow [1MM1]. Composition [1MP2]. Disease [1MP1]. Blood [1P1].
Step 4.	Transformed Title	Child medicine (BS). Blood [1P1]. Disease [1MP1]. Fatty acid-Bone marrow [1MM2]. Composition [1MP2].
Step 5.	Title in standard terms with Indicator Digits	Child medicine (BS). Blood [1P1]. Disease [1MP1]; Fatty acid-Bone marrow [1MM1]; Composition [1MP2].

Step 5 for the second subject of the document will be:

Child medicine (BS), Blood [1P1]; Disease [1MP1]; Bone marrow [1MM1]; Fatty acid [1MM2]; Composition [1MP2] *influenced by* Child medicine (BS), Blood [1P1]; Disease [1MP1] : Treatment [1E], Adrenocorticoid [2MP1].

2 POSTULATES AND PRINCIPLES

In facet analysing the subjects mentioned in Sec 1 according to the Method of Postulates, some or all of the following Postulates and Principles of Classification (1) may be involved:

1 Postulate of Basic Subject;

2 Postulate of Fundamental Categories;

21 The isolate ideas deemed to be manifestation of Matter are to be grouped into Matter-Material and Matter-Property;

3 Postulate of Round;

4 Postulate of Level;

41 In one and the same Round of a Compound Subject, if there are two isolates, one of which is deemed to be a manifestation of Matter-Material and the other is deemed to be a manifestation of Matter-Property, then the sequence between these two isolates should be Matter-Material, Matter-Property, according to the Principle of Decreasing Concreteness in Class Number. In other words, Matter-Property is deemed to belong to a later level in relation to Matter-Material;

5 Postulate of Level Cluster;

6 Postulate of Sequence within a Round; and

7 Principles for Facet Sequence.

3 SEQUENCE OF KERNEL IDEAS

In the facet analysis of the subjects mentioned in Sec 1, the sequence among the Kernel Ideas was determined in each case with the aid of the Wall-Picture Principle and its corollaries (2). According to the Postulate of Decreasing Concreteness in Class Number, the Postulate of Level Cluster, and the Postulate about Level of Matter, the sequence of the Kernel Ideas in a Compound Subject would be as follows:

(BS), [1P1], [1P2] , ... ; [1MM1] ;
[1MM2] ; ... ; [1MP1] ; [1MP2] ; ... :
[1E]

followed by later Rounds of [P] and [M], if any. For the time being, we need not consider [S] and [T].

4 APPARENT REVERSAL OF SEQUENCE

In the facet analysis of each of the subjects mentioned in Sec 1, it may be seen that the sequence between Matter-Material and Matter-Property is reversed. As mentioned in Sec 3, the sequence of Kernel Ideas in the subjects of the examples in Sec 1 was determined using the Wall-Picture Principle and its corollaries. Thus, it would appear that in the Matter facet, the sequence of the Kernel Ideas derived according to the Wall-Picture Principle is in opposition to the sequence of the Kernel Ideas derived according to the Postulate of Concreteness, the Postulate of Levels of Matter, and the Postulate of Level Cluster. For example, let us consider the sequence of Kernel Ideas in Example 3 mentioned in Sec 1 according to the Postulates.

Subject: Bone marrow fatty acid composition in children with hematological disease.

Step 5 of Postulational Method:

Child Medicine (BS), Blood [1P1], Bone marrow [1P2]; Fatty acid [1MM1]; Disease [1MP1]; Composition [1MP2].

This analysis presents a sequence of the facets in conformity with the Postulate of Decreasing Concreteness, the Postulate of Levels of Matter, and the Postulate of Level Cluster. But the subject represented in this analysis is not at all coextensive with the subject of the document under consideration. Indeed it gives a distorted representation of the subject. For, "Disease" is not that of the "Fatty acid of the bone marrow", the "Composition" studied is that of the "Fatty acid of the bone marrow" and not of the "Disease" ! The distortion in representation of the subject is thus due to the intrusion of the Kernel Ideas "Bone Marrow" and "Fatty Acid" between the two inseparable though distinct Kernel Ideas "Blood" and "Disease". This violation of Facet Syntax (5) and the Theory of Bond Strength (3) should obviously be avoided in Classification.

5 SOLUTION TO THE PROBLEM

A solution to the problem may be considered from the following angles:

1 Examination of whether there has been any latent fallacy in the facet analysis of the subjects mentioned in Sec 1;

2 Different ways of facet analysis of the subjects;

3 Level Cluster concept;

4 Postulate of Levels of Matter; and
5 Not considering "Property" as an Isolate.

51 Latent Fallacy in Analysis

For each subject mentioned in Sec 1, the Steps 0 to 5 are given. The analysis is fairly straightforward as each of the subjects is not complicated by any hidden idea. Thus, there is apparently no cause for any fallacy to be introduced in the analysis. A number of subjects wherein such a problem in sequence of facets is likely to arise were selected. When there was any doubt about the sequence of facets with respect to a subject, it was not selected for consideration. Out of the remaining examples, the subjects presenting least difficulty in facet analysis are mentioned in Sec 1.

52 Different Facet Analysis

520 Foundation of Freely-Faceted Classification

Each subject has a Facet Syntax. It parallels the Absolute Syntax of Ideas of the majority of specialists in the subject. The sequence of Kernel Ideas derived on the basis of the Wall-Picture Principle and its corollaries parallel the Facet Syntax in each subject. These ideas are the hidden but basic foundations on which the Theory of Freely-Faceted Classification has been built up (5). The facet analysis in each of the examples mentioned in Sec 1 coextensively represents the respective subjects and the facet sequence in each case correlates with the Absolute Syntax of Ideas as the sequence has been derived on the basis of the Wall-Picture Principle. Therefore, alternative ways of facet analysis would be inexpedient for the subjects under consideration. However, a different angle of approach to a subject may be possible. This is considered in the succeeding sections with respect to the subjects mentioned in Sec 1.

521 Example 1 in Sec 1

Subject: Detection of particles entrained in
seeds and blisters in glass.

The facet analysis at Step 5 may give the following pattern of Kernel Ideas:

Chemical production technology (BS), Glass [1P1];
Particle-Entrained-Seed and Blister Defect
[1MM1] : Detection [1E].

Here, the locus or environment of the "Particle" is taken to be specified by "seed and blister". Therefore, the latter is represented as a Qualifier to the former.

This facet analysis of the subject appears to be satisfactory. There is also no violation of the postulates about facet sequence.

From the discussion in Sec 52 so far, it would appear that the facet sequence

1 Chemical Production Technology (BS), Glass [1P1]; Seed and Blister defect [1MP1]; Particle-Entrained [1MM1] ; Existence [1MP2]: Detection [1E]

given in Sec 11, and the facet sequence

2 Chemical Production Technology (BS), Glass [1P1]; Particle-Entrained-Seed and Blister [1MM1] : Detection [1E]

are helpful to the majority of the specialists in Glass Production Technology.

The choice between the two facet analyses is then to be based on the extent of their helpfulness to the specialists. In such a choice, we may take into consideration the following factors:

1 The Class Number constructed on the basis of facet analysis 2 will place the documents dealing with "Seed and blister defect" in glass quite removed from the documents dealing with "particles entrained in seed and blister" in glass.

2 Particles may cause seeds and blisters in glass -- that is, particle can be a causative agent of seed and blister.

3 Glass technologists study entrained gas and particles in association with and to gain more knowledge about the formation and avoidance of formation of seeds and blisters.

Considered from this angle of helpfulness of the sequence of the subjects to the Glass Technologist, it would appear to be more helpful if documents on "seeds and blisters" and those on "particles entrained in seeds and blisters" are not widely separated. Hence, the facet sequence derived according to facet analysis 1 would be more fully expressive and helpful to the specialists concerned.

522 Example 2 in Sec 1

Subject: Serum protein pattern in patients with fractures.

The facet analysis at Step 5 may give the following pattern of Kernel Ideas:

Medicine (BS), Blood [1P1]; Serum Protein [1MM1] ; Variation [1MP1] influenced by

> Medicine (BS), Bone [1P1] ; Defect-Fracture [1MP1].

Here, all the Kernel Ideas in the subject are represented. There is also apparently no violation of the Postulates. But a Compound Subject has been treated as if it were a Complex Subject. This violates the Theory of Strength of Bond among Kernel Ideas in a subject (5). Further, the subject will now be placed among documents on Blood. This position will be quite removed from other documents dealing with the main focus of the subject under consideration -- namely, Bone fracture and its physiological consequences. Such a dispersal of closely related subjects would not be helpful to the majority of the subject specialists likely to use these subjects. Thus, deeming the subject as a Complex Subject is only a forced way to get over the problem of sequence of facets mentioned in Sec 4.

523 Example 3 in Sec 1

Subject: Bone marrow fatty acid composition in children with hematological disease and after adrenocorticoid administration.

The facet analysis at Step 5 may give the following pattern of Kernel Ideas:

> Medicine of child (with haematological disease) (BS), Bone marrow [1P1] ; Fatty acid [1MM1]; Composition [1MP1].

Here, the sequence of Kernel Ideas is apparently helpful. There is also no violation of the Postulates. But the formation of Compound (BS) such as "Child with haemotological disease" with Medicine as its Host Main Subject may lead to forming even more complicated Compound (BS). For example, for the second focus of the subject in example 3, we can form a Compound (BS) such as

Medicine of Child (with haemotological disease treated by adrenocorticoid).

The problems arising from the formation of such Compound (BS) have to be investigated. This kind of Compound (BS) arises because in CC, "Child Medicine" is a Specials (BS) with Medicine as its Host Main Subject. The question arises: Would it be helpful to have the Kernel Idea "Child" -- that is, Child Body -- as an isolate in [1P1] in subjects going with the (BS) Medicine? Or, should the isolate "Body" be brought out explicitly in the Personality Facet and Qualifiers attached to it in the usual way? These questions will have to be examined in the total context of the concepts of Specials (BS) and Systems (BS).

53 Level Cluster Principle

Is the Level Cluster Principle unhelpful because the sequence of Levels of Matter derived on its basis is in opposition to the one derived according to the Wall-Picture Principle? It is also the experience that in the case of Levels in all other facets, the Level Cluster Principle holds good. Is then the idea of Levels in Matter facet an exception to this principle? The trouble appears to be due to a particular attribute of Isolates deemed to be Property Isolates. In Paper BC contributed to this Seminar, it has been pointed out that a "Property" can occur in association with any kind of Isolate Idea in a Compound Subject.

Thus, we can have in a Round in a Compound Subject:

1 A Personality Isolate with a "Property" associated with it;

2 A Matter-Material Isolate with a "Property" associated with it;

3 A Property Isolate with a "Property" associated with it; and

4 An Energy Isolate with a "Property" associated with it, ending the Round.

If we concede that Facet Syntax and the Theory of Bond Strength require that in the analysis of the Compound Subject

1 The Personality Isolate and the "Property" associated with it be kept together;

2 The Matter-Material Isolate and the "Property" associated with it be kept together; and

3 The Property Isolate and the "Property" associated with it be kept together,

then, a violation of the Level Cluster Principle arises automatically. The examples in Sec 1 illustrate this.

54 Postulate of Levels of Matter

From the discussion in Sec 53, it would appear that this Postulate brings in rigidity in recognising the "free" occurrence of a "Property" in association with any kind of Isolate and in implementing this finding in classification. Thereby, we fail to respect the uniqueness of the "Personality" of a subject. This is a violation of the basis of the Theory of a Freely-Faceted Classification. The discussion so far leads to the point when we may consider whether the Idea of "Property" needs to be

4

deemed to be an Isolate. This is discussed in Sec 6.

6 "PROPERTY" AS A NON-ISOLATE IDEA

61 Kinds of Kernel Ideas

The Kernel Ideas forming the components of a Compound Subject fall into three major groups:

1 Isolate;
2 Qualifier; and
3 Basic Subject.

According to the Postulate of Fundamental Categories, an Isolate alone (excluding the Anteriorising Common Isolate) can be deemed to be a manifestation of one or other of the Fundamental Categories.

62 Idea of Property

The generation of the idea of Property while designing a scheme for classification has been discussed in Paper BC of this Seminar. The association of such an idea with any kind of isolate has also been pointed out. That is, it is an ubiquitous idea. For various reasons, the idea of Property has been deemed an Isolate and its manifestation taken to be that of the (FC) Matter. An isolate is expected to obey the various other Postulates and Principles of sequence. We have seen the problem in this respect in the case of Matter-Property Isolate. Taking into consideration the two attributes of a "Property" -- its

1 Ubiquitousness -- that is, occurring in association with any of the other isolates in a Compound Subject; and

2 Claim for a position in a Compound Subject violating certain Postulates about sequence of Isolate Facets, one is inclined to think that

"Property" need not be considered as an Isolate Idea. If a "Property" is not an Isolate Idea, is it one of the other two kinds of Kernel Ideas -- Basic Subject and Qualifier? A "Property" can occur either in association with a (BS), or any of the isolate ideas in a Compound Subject. By itself "Property" may not be a (BS). A "Property" can occur as a Qualifier as in "Hard Pencil"; It can also occur as Property *qua* Property as in "Hardness of Pencil". The present discussion is concerned with "Property" occurring as "Property *qua* Property". Thus "Property" can be taken as another kind of Kernel Idea occurring in Compound Subjects.

7 HELPFULNESS OF TREATING "PROPERTY" AS NON-ISOLATE IDEA

71 Advantage

If we consider "Property" as an idea attachable to the (BS) and any of the Isolate Ideas in a Compound Subject, then

1 The problem of facet sequence mentioned in Sec 4 can be solved;

2 The uniqueness of the "Personality" of a subject can be fully respected;

3 The idea of freely-faceted classification can be more fully utilised;

4 The rigidity in sequence of Kernel Ideas imposed by certain of the Postulates can be reduced appreciably; and

5 Considerable flexibility for the interpolation of "Property" in the class number can be achieved, the position of a "Property" in relation to other Kernel Ideas in a Compound Subject being determined by the Wall-Picture Principle.

72 Indicator Digit for "Property"

To get a helpful sequence among Compound Subjects, the Indicator Digit for the idea of "Property" should have an ordinal value between the Energy Facet Indicator Digit " : " (Colon) and the Personality Facet Indicator Digit " , " (Comma). The present Matter-Property Indicator Digit " ; " (Semi-colon) may with its present ordinal value in CC, be retained to indicate the idea of "Property". In its new use, it is not a facet indicator. The idea of "Property" occurs with a relatively higher frequency than the Matter-Material isolates even in the field of Natural Sciences. The frequency of occurrence of Matter-Material isolates in the subjects falling in the field of Humanities and Social Sciences is relatively negligible. Hence, an existing Indicator Digit recommended for use to indicate the idea of "Property". A new Indicator Digit for Matter-Material Isolate may then become necessary. Use of different Indicator Digits for Matter-Material and Matter-Property is already under discussion since 1967.

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DRTC Seminar (7)(1969). Paper BE.

COMPUTERS AND CATEGORISATION.

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The present trend in data handling systems is to concentrate on application systems process control problems, because it is easier to do so with computers. This may turn out to be premature until the classification problems are resolved. The discipline of classification varies in emphasis depending on what phenomena are in focus. The classification of subjects is similar to the classification of objects. For the purpose of categorisation, facet analysis can be used helpfully. The concern should be with classes of characteristics for different referents as identifiable items and with their quantification. The operation of displaying, relational logic, process control, updating, and editing, must be designed similarly for every kind of referent. The same similarity of design applies also to the method of recording classes of characteristics, for all sorts of data, and to the structural form of data and data description. The rationalisation of data description into a master list (Meta Data) is a revolution. It is a classification problem not concerned with computer. The data description of the structure of the data content (System Data) is also a classification problem. Classification problems relating to storage structures and machine structures are completely concerned with computer. The ability to redesign the constructs both of the items to be processed and of the processing artifact relies entirely on classification schemes which have organised the characteristics of these referents.

0 TERMINOLOGY

01 Data Description

A data description is a name for a characteristic of some phenomenon as a referent entity.

02 Object Data

The classification of referent entities recorded as identifiable items in a record takes the form of classes of characteristics. This type of data is referred to as Object Data.

03 Meta Data

Data descriptions are unique textual descriptions of characteristics used to describe identifiable items of object data and system data. In order to control the uniqueness of the textual description (and its numeric code with its class), data descriptions must be coherent. It is the function of Meta Data to resolve problems of uniqueness with respect to semantics, order within and between classes, and numeric coding within classes. The result of meta data control of data description is a unique list of classes of characteristics.

04 Meta Data and System Data

The uniqueness of all data description (including System Data) is controlled by Meta Data. However, the form of all Data and Data Description (including the Meta Data - Master Codelist) is controlled by System Data.

05 Norm and System Data

The Norm of a Data Description is always of the form 'numeric code has textual description'. (This can be expanded n-adically to include equivalent textual descriptions and classification codes). The Norm for Data is always of the form 'identity code is in some relation code to some nominal and/or real number and/or string or text. The Norms which define the form of a Data Description Record and of a Data Record are controlled by System Data.

06 The Relational Process

Textual description and numeric code ⟶ Data description relational record.

Identity code content (nominal code, number or text) ⟶ Data relational record.

1 SCOPE OF THE PAPER

11 Present Attitude towards Program Management

The management of a large programming effort is a wasteland. Either the thing is overpowered with funds and people or two or three people make a breakthrough. In either case, if the outcome is a working system, it will always be oriented towards programmer's comfort and convenience. Their problems came first and they are usually incapable (not necessarily unsympathetic) of perceiving a program management system as something else. This paper is essentially about that difficulty. If computers are to be used as an integral part of a complex administrative situation, then illustrative rhetoric and extensible procedure languages and list structured file systems will help, but they will not get us there.

12 Potentiality of Similarity in Design

The concern should be with classes of characteristics for different referents as identifiable items and with their quantifications. The operation of displaying, relational logic, process control, updating and editing must be designed similarly for every style of referent. The same similarity of design applies also to the method of recording classes of characteristics for all sorts of data, and to the structural form of data and data description. Many files must be accessible on a comparative basis without all the burdensome work being done by people slaves. Users must be able to rename things from their own point of view, but if they do not wish to exercise their option, the system must apply its own named information in an easy-to-access and easy-to-understand fashion.

13 Requisite Management System

The data management system and data description management system, which would be required, are specified in this paper. At the beginning of this century, Cutter, Dewey, Hulme and others using people and cards tried to do something about classification of the sciences with respect to collections of documents. We are concerned with classification in the the behavioural and computer sciences. We also have computers as well as cards and that makes the trying harder.

2 INTRODUCTION

21 Referent

All that keeps changing during the discussion is the referent entity. As a paradigmatic example, consider, on the one hand, a pile of identical personnel questionnaires completed by many different people and on the other, a pile of many different personnel questionnaires which have been left empty. In the former case, the referent is the person and in the latter case, the referent is the empty questionnaire.

22 Characteristics of Referent

What remains the same is that characteristics of referents are in classes, and can be operated upon by the same relational logic and the same display operations. A data description about a data description is called meta data. Meta data is index term, dictionary and thesaurus type of data.

23 List of Classes of Characteristics

What also remains the same is that lists of classes of characteristics which are all records. These records must be embodied and take a certain form. The description of this form must not only take into account external representation, but the internal representation in the computer and also of course, the operations on these forms. This data is called System data.

24 Problem of Quantification

Quantification of item identities for certain characteristics is similar whatever the referent. But the measurement properties of characteristics vary a great deal with the type of referent. When the items in a universe are a complete set this is different to when the items are a sample from this universe.

25 Present Attitude towards Classification

The difficulties mentioned in the previous paragraph affect quantification rather than classification. A quarter of a century ago, a very strong effort was made to introduce rigour into classification in the social sciences. (Note not classification of the social sciences). This was concerned with efforts to define well-formed theory statements and involved backbreaking efforts to analyse the content of text. The considerable clerical work required to support this intellectual activity blunted the effort. A decade ago, hope was stirred by computers. However, the present trend is to relegate classification problems and content-rate on application systems process control problems because this is easier to do with computers. This may turn out to be premature until classification problems are resolved.

3 CLASSIFICATION

A data description is a name for a characteristic of some phenomena as a referent entity. The classification system is the arrangement of the characteristics according to some scheme. The discipline of classification varies in emphasis dependent on what phenomena are in focus. Classification systems differ from each other in the following features:

1 The fitness of the characteristics, that is, absent vs present or according to some measurement scale, for example,.hardness.

2 The order of the characteristics, linear or inclusive.

3 The dependency of characteristics, for example, equipment or contingent.

These features are pertinent when considering both particular characteristics and classes of characteristics.

31 Classification and Subject Heading

The Subject Catalogue has topics as its objects. The classification scheme is composed of characteristics which are the subject headings able to classify the subjects covered by the topics. The classification of subjects is a discipline similar to the classification of objects. Usually, however, some characteristics are equivalent across classes as well as some inclusive between classes.

32 Facet Analysis vs Conventional Subject Cataloguing

However, the classification of data description, that is, the classification of the names for the characteristics can be made a problem in grammar or a problem in unique index term categorisation in a classification via a Thesaurus. Data descriptions are where possible recorded as index terms. These are then reconciled into master lists. There are some synonym thesaurus problems, and then the index terms are classified into categories. This type of facet analysis can be used instead of the conventional subject cataloguing.

4 COMPUTERS AND CATEGORISATION

41 Data Handling

Data handling with digital computers is concerned with data description of the data and then acquisition and analysis of the data via the data description.

Data handling is a symbol manipulating activity primarily concerned with

1 Categorisation (detailed specifications of data descriptions):

2 Assignment (applying the pertinent specifications to cases and identifying the cases): and

3 Quantifying (counting and measuring the cases with respect to their specifications).

42 Internal Representation Vs External Representation

Internal representation is concerned with embodiment of the data. External representation is concerned with how the data is used to represent externals. Data handling is concerned with both and can be exemplified at many different levels.

Externals are content categorisations of the characteristics of thought, of behaviour and artifacts, and of language. Internals are embodiment categorisations of the characteristics of storage structures and physical structures.

43 Categorisation: Definition

Categorisation can be defined as

1 The naming of each possible characteristic of an entity;

2 Each characteristic as an element in relation with other elements is usually called a structure;

3 Characteristics are usually subdivided (under a particular category) into varieties which may be ordered (arranged in a sequence): and

4 The more a structure has in its design procedural information as to its use, the more sophisticated is the structure.

44 Assignment

Assignment can be defined as

1 The choice of a particular characteristic for the purpose of identification of an entity; and

2 The identified entity as a recorded item may have some or all of the other elements as characteristics.

Examples from different levels of data handling illustrate structures and operations common to the various levels.

5 OBJECT DATA AND INVENTORY CATALOGUE

51 Object Data

A personnel file has people for entities. The specifications (elements in relation) suitable for a recorded item are the various pertinent topics -- eg, occupations, skills, age, income, etc, which describe the entity. Topic headings usually group the topics. Each topic -- for example, occupation is categorised into the characteristics which are particular occupations -- for example, doctor, lawyer, etc. A census file perceives both people and households as entities. The characteristics required to specify a household are different to those needed for people. The identification of a particular recorded item is usually name or address or ID Number. Operations are concerned with

1 Identifying a set;

2 Indexing a subset;

3 Inclusive relations; and
4 Cross reference relations.

52 Inventory Catalogue

These files or data sets are essentially handbooks. They contain factual data and attitudinal data about people, households, districts, regions, etc. A file of several thousand handbooks may be called an Inventory Catalogue.

521 Identification of a Handbook

The inventory is also a data set. The entity is the handbook or more precisely the data descriptions for each handbook. The specifications suitable for recording the handbook as an item are the various pertinent features -- for example, collection organisation is categorised into the characteristics which are, in this example, the particular collection organisation(s). An inventory catalogue is really the author-title catalogue for handbooks. The identification of a particular handbook is usually archive number or study name.

6 META DATA

The topics in each handbook, which have been categorised into their characteristics cover a range of subjects especially when the collection grows to several thousand handbooks or more appropriately several collections, each with hundreds of handbooks.

61 Subject Classification

A subject catalogue has topics for entities. The specifications suitable for a recorded item --

that is, a particular topic in a handbook is a conventional subject heading - sub-heading scheme -- for example, international relations - foreign aid, would classify all topics in all handbooks, dealing with this subject. The identification of a particular topic item is usually handbook archive number and topic name or number.

62 Master Codelist and Target Codelist

621 Master Codelist

However, many topics are categories of characteristics in a well-defined sense -- for example, the list of particular occupations for each of several thousand handbooks reveals the possibility of a master occupation list.

In the subject catalogue, the focus is a subject code which classifies the pertinent topic in the handbook. A master codelist is a subject classification scheme which is specific at the level of data description for each characteristic both in the classification scheme (master codelist) and that which is classified (the target codelist).

The master codelist is a detailed data description of data descriptions. For example, the master codelist of 'occupation' lists in order all of the pertinent occupations and the code for each. The entity is the particular occupation -- for example, journalist.

622 Target Codelist

The specification of this recorded item is the particular code and pertinent data description on each target codelist -- that is, each codelist of 'occupation' as occurs in each handbook. As each target codelist lists in order its pertinent occupations and the code for each, the problem is one of using a master list of index terms to control the index terms in the handbooks. The identification of a particular target codelist is the name of the target topic and the archive number of its handbook. The master codelist (meta data) must know that 'occupation' is equivalent to 'job' and likewise for 'journalist' and 'newspaperman'. A subject catalogue would only know that the subject of 'factual data' -- 'occupation' exists in the pertinent handbooks.

63 Interrelation

The master codelist for 'occupation', 'religion', etc, can be extended to areas where the target codelists are not equally well-defined. The problem is that of producing target codelists from short passages of text, each of which compromises a topic under control of a master codelist. This problem of producing index terms and categorising lists of terms can be accommodated by the structures and the operations. Furthermore, the statistical tests available to test distributions of object data (census etc) can be used for meta data (index terms).

7 SYSTEM DATA

The difficulties of external representation caused by problems in philosophy of language do not prevent the development of structures and operations which will accommodate the intellectual effort. However, the various levels just discussed must be embodied in some internal representation which, in turn, exists at various levels.

71 Storage Structure

A storage structure in a computer has locations for entities. Particular locations are the elements which are related according to some rule which reflects the way in which procedures will search and update the storage structure. The relations available to the designer of a storage structure are basically physical contiguity of locations and address of locations.

The ability to specify a storage structure as a recorded item must rest within the pertinent computer language. The identification of a particular storage structure is some prime location within it. Operations are those required for computer language compilation and interpretation.

Examples of storage structures are arrays, lists, trees, rings. They exemplify in varying degrees sets of locations, indexes to locations, hierarchical locations, and cross references to locations.

Personal files, inventories, subject catalogues. master codelists are respectively sets of people, handbooks, topics and specific data descriptions each with its numeric code. Each of these exhibiting indexes, hierarchies and cross references to the relevant entity, which in these examples is not a location but a content code.

The more complex the defined structure of locations (and of content) -- that is, the more procedural information is built in the storage structures (and content structures) then, the less procedural information needs to be known by the user.

72 Machine Structure

A physical structure in a computer has to be concerned with entities which are both small and large physical chunks. A small chunk is the computer word. The elements are the bits in relation in the computer word. There are many categorisations for bit configurations which define the relations within a computer word. The word is either perceived as an instruction -- for example, operation code, address, modification register, indirect address, etc-- or when a word is perceived as a storage location for data -- for example, binary integer, decimal integer, ASCII character, etc. The identification of the recorded item is the absolute location of the particular computer word. Operations at this level are machine language operations.

A larger chunk is the 'page'. The elements are computer words in sequential arrangement. The identification of a page is the serial number within its segment (discussed below). The operations which seek out a page are in the hardware (for example, small associate memories) and in specially designed machine language instructions .

In general purpose computing facilities storage structures are used to relate computer words quite independent of the pages in which the words happen to fall. Consequently, complex storage structures may severely tax the page seeking machinery and undercut claims of efficiency and quick response.

A segment is a storage structure which physically is a sequence of pages. Particular page serial numbers are the elements in relation. Identification of a segment is by its name. Operations are instructions in the organisation language of the host computer system.

The smaller storage structures such as arrays, list, etc, need to be optimised as segments which can be related to each other in efficient fashion. Segments as elements have to be large enough to avoid a plethora of uneconomic relations.

Segments are elements in a file (sometimes data set). The identification is by some file name which relates the segments together. The physical structure for a segment is a disk record which is a contiguous length of computer words of a certain size. One or more disk records are used to accommodate a segment. Disk records are usually larger chunks than are pages.

Within the framework of current hardware technology, the segment-page approach is basically sound. Therefore, the problem is to design storage structures that fit neatly and economically into a page segment approach. However, it has to accommodate the content structures.

73 Content Structure

Content structures are concerned with the various levels of external representation which have been discussed above. The operations are those procedures required for acquisition and analysis of the data.

8 PROCESS CONTROL

Computer languages provide the facility for expressing storage structures which are translated into physical structures at various levels of procedure for processing and control.

These procedural computer languages do not have facilities for externally oriented data types. The computer programmer must keep the relationships between subroutine calls consistent according to his own conventions.

The definition of conventions for types of real number, for numeric and alphabetic code, and for arrays and list structures by means of which a computer language can be used for content structure specifications is still at an early stage of development.

81 Data Management via System Data

When some usable categorisations have been developed, there is still another problem which we have discovered after working in this area for a few years.

When all of the data and data prescriptions are computer usable, and all data management is computer based, there has to be data about system control and use.

System data records the disposition of the storage and physical structures that have been selected to embody the content structures of data and data description. As the states of the content data are changed by user instruction of operator-operand sequences of an arithmetic and logical nature to be performed on existing content data, a trace at both the storage and physical structure level (where is it located, how did it get there) and at the content level (what was it named, what does it mean) is maintained in the system data.

A system data set relates the content structures (using such categories as 'category', 'relation', etc) to the storage and physical structures (using such categories as 'disk location', 'core memory location', 'page name') and to the operations upon content structures (using such categories as 'operator', 'qualifier', etc). Furthermore, as system data specifications cover system data itself, the system data categories and relations (eg, 'page name' of 'relation' is at 'disk location') are themselves described in system data relations (eg, 'relation' is formed from 'relation name' and 'category') as well as the object data description (eg, 'person' has 'occupation' in 'data set').

82 Data Description Management via Meta Data

Operations are performed at a variety of levels (eg, operating on code lists as a target, operating on data as a target, operating even on system data as a target) and by a variety of users.

It is desirable for many reasons to maintain the system data in the same storage structures as the object and meta data (master codelists). This desiderata has implications for the recursiveness of the definition of the storage structure, of the system data itself, and of the procedures (programs) for accessing the storage structures.

83 Quantification

Quantification of items at the various levels can be done systematically for many different purposes given usable data structures and operations which can trace aggregates back to particular items despite any transformation and/or statistical test.

Given the wide variety of items discussed mainly to emphasise the categorization, a detailed discussion of quanitification is outside the scope of this paper.

However, social scientists, management scientists, information scientists, and computer scientists do perform remarkable similar system studies on their particular phenomena.

9 CONCLUSION

91 Rationalisation of Data Description

The data description of a data code is an old convention in computerized data handling. However, categories were only known by their field location. The activation of categories as data descriptions with data codes is a computer usable improvement with many implications. The rationalisation of data descriptions into a master list (Meta Data) is a revolution. The classification problems are dictionary and thesaurus type problems which have little to do with computers.

92 Description of Structure of Data Content

The data description of the structure of the data content (System Data) both as to its display (that is, changing the layout of the same form) and in to its form (that is, changing the form) is also a classification problem. The characteristics of the referents have little to do with computers. But many computer conventions have grown up over the years which make it seem like a computer problem. Classification problems into storage structures and machine structures are completely concerned with computers. The data structure (content structure) problem however becomes a computer problem when the classification of the structure of content is complete and there is a desire to embed it in a procedure language. The problem of the compiler design spills over into storage structures to be executed on a particular machine. The design of advanced compilers is an important computer problem.

93 Role of a Classification Scheme

The characteristics of referents which are to be processed through artifacts which as referents themselves have their own characteristics (Process Control) over a time period rests on constructs which are defined by classification schemes. Whereas in meta data the emphasis is on characteristics, in process control the emphasis is on control of the flow of quantified item identities. Concepts of activities, events, transactions, etc, are in focus. Items with certain characteristics can access activities which continue in parallel. System flow with actual data or simulated data can only really be done properly with a computer. Modern languages with pure procedures, storage tables separate form program code makes implementation of these applications systems even more reliant on a computer. However, the ability to re-design the constructs both of the items to be processed and of the processing artifact relies entirely on classification schemes which have organised the characteristics of these referents.

DRTC Seminar (7)(1969). Paper CA.

POSTULATE-BASED SUBJECT HEADING FOR DICTIONARY CATALOGUE SYSTEM.

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In the Classified Catalogue System (= CCS), the Specific Entries for subjects going with the different Basic Subjects, and those for the Compound Subjects going with one and the same Basic Subject are brought together and arranged in a filiatory sequence. All the other features of the CCS, excepting the 'filiatory sequence' can be incorporated in the Dictionary Catalogue System by (1) making its subject cataloguing base on Postulates of Facet Analysis and Principles of Facet Sequence; and (2) adopting the Forward Rendering Method for the Specific Subject Heading (= SSH) determined on the basis of the Title-in-Standard-Terms arrived at in Step 5 of the Method of Postulates. A General Subject Entry (= GSE), prepared on the basis of the SSH by using each of the Sought Terms as the First Heading followed by the other terms in it as in a cyclic permutation, provides access to the Specific Subject Entry by any Sought Term occurring in the SSH. To help in determining the correct SSH in the Heading of a GSE itself and to obviate the need of mentioning the Referred-to-Heading, a virgule (/) and a full stop (.) are used to indicate its beginning and end respectively.

Abbreviations Used

CCS = Classified Catalogue System

DCS = Dictionary Catalogue System

0 LAWS OF LIBRARY SCIENCE AND DOCUMENT FINDING SYSTEM

To satisfy the Five Laws of Library Science, a document finding system should help in the

1 Promotion of the use of documents (Law 1);

2 Selection of just those documents coextensive with the specific interest of the reader at the moment (Law 2);

3 Selection of all the documents relevant to the specific interest of the reader at the moment (Law 3);

4 Expeditious selection and supply of all the documents of specific interest to the reader at the moment (Law 4); and

3 The achievement of this economically in spite of the continuous increase in the number of documents of all kinds.

In designing a document finding system satisfying the above-mentioned standards of service, problems arise mainly when the reader's question relates to information about a subject. Therefore, this paper confines itself to a discussion of the capacity of document finding systems to meet the query of readers about subjects.

1 CLASSIFIED CATALOGUE SYSTEM

11 Devices for Efficiency

The CCS has the capacity to meet the above standard of service to a high degree. The design, use, and value of a CCS have already been described (4, 5). The efficiency of the system is considerably increased when

1 The Class Number for the documents are derived on the basis of a Freely Faceted Scheme for Classi-

fication founded on a dynamic General Theory of Classification;

2 The Feature Headings are derived according to a Postulate-Based Subject Indexing such as Chain Indexing; and

3 The Class Index Entries are also derived according to a Postulate-Based Subject Indexing, such as Chain Indexing.

12 Helpful Feature

The helpful features of the CCS designed in the manner mentioned above are as follows:

1 The display of entries for documents so as to give an arrangement

11 Of the Compound Subjects going with different Basic Subjects helpful to the majority of readers,

12 Of the Compound Subjects going with one and the same Basic Subject helpful to the majority of readers, and

13 Of the components of a Compound Subject going with a Basic Subject helpful to the majority of readers;

2 Consistently maintaining the pattern of arrangement of subjects as mentioned in 11, 12, and 13 above;

3 Facility for a reader-librarian-document finding system dialogue as an aid in the precise formulation of the reader's query;

4 Facility for browsing among the entries as an aid in the choice of document; and

5 Facility of approach to the entries for documents on the specific subject of interest of the reader at the moment through the name of any one or more of the components of the subject.

Such a CCS is, therefore, the closest practical approximation of the document finding system fit to satisfy the Laws of Library Science. It can be used as a standard for evaluating the capacity of other document finding systems.

2 DICTIONARY CATALOGUE SYSTEM

21 Approximating the CCS

The DCS is a widely used system for document finding although its capacity to satisfy the Laws of Library Science is of a lower order than that of the CCS. We thought it worth examining whether the features of the CCS that make it an efficient document finding system as mentioned in Sec 12 can be incorporated in the DCS. And if so, to what extent?

3 POSTULATES AND PRINCIPLES FORM A COMMON BASE

The recognition of the possibility of improving upon the efficiency of the DCS arose from the realisation that the process and steps of classifying, designing a scheme for Classification, and the formulation of Feature Headings and of Subject Headings could all be based on one and the same set of Postulates of Facet Analysis and Principles of Facet Sequence.

The methodology used for the teaching of practical classification in DRTC using different schemes for classification was an aid in this realisation. Using the Method of Postulates (7) the Facet Analysis of subjects of the document concerned is carried through Steps 0 to 5 irrespective of the Scheme for Classification used to construct the Class Number at

Step 8. The Subject Heading -- Feature Heading or Class Index Heading -- is derived by applying the Chain Procedure to the Class Number constructed in the manner mentioned above. If it is a Feature Heading the Terms and their sequence are the same as those in the Title-in-Standard-Terms arrived at Step 5, without, of course, the labels for each of the Kernel Terms. If it is a Class Index Heading the sequence of the Kernel Terms will generally be reverse of that of the Feature Heading. This implies that the Feature Headings and the Class Index Heading for a subject can be formulated on the basis of the result of the Facet Analysis at Step 5 of the Method of Postulates. In other words, the Class Number need not be involved in the formulation of the Subject Heading. This has been discussed in a paper by S R Ranganathan in 1964 (9) and also in his paper CB contributed to this Seminar (8).

4 UNHELPFUL SUBJECT HEADINGS IN DCS

As has already been mentioned in Sec 12, the value of the CCS arises from its capacity to display in a helpful filiatory sequence the entries for documents embodying Compound Subjects going with one and the same Basic Subject and those going with different Basic Subjects. The Specific Subject Headings for the DCS have so far been derived in the same manner as the Headings for the Class Index Entries of the CCS. That is, applying the Chain Procedure to the Class Number and formulating the Subject Heading by the Reverse Rendering Method. This leads to the scatter even of the entries for documents embodying Compound

Subjects going with one and the same Basic Subject, according to the alphabetical make-up of the terms in the Subject Heading. Here are a few examples of Subject Headings for Compound Subjects going with the Basic Subject "Medicine":

Anatomy, Liver, Medicine
Anatomy, Medicine
Disease, Esophagus, Medicine
Liver, Medicine
Surgery, Colon, Medicine
Surgery, Liver Medicine

If we introduce among the above Subject Headings other Subject Headings for Compound Subjects going with different Basic Subjects, the scatter of the related subjects becomes even more chaotic.

5 PROJECT ON SUBJECT HEADING FOR DCS

About April 1968, a project was taken up to examine the helpfulness of Subject Headings derived by the Forward Rendering Method with respect to the DCS.

51 Preliminary Findings

In an article dealing with Class Index Headings for micro subjects (2) the helpfulness of Forward Rendering of the Class Index Headings has been mentioned. This amounts to reading a Heading for a Class Index Entry as if it were a Feature Heading. The preliminary findings of the project were discussed in the DRTC Weekly Colloquium 12 of 4 December 1968. The topic discussed was "Forward Rendering vs Reverse Rendering". The helpfulness of Forward Rendering of Subject Headings in a DCS was demonstrated with examples. A particular advantage convincingly demonstrated was the collecting together of Compound Subjects going with one and the same Basic Subject, which would be scattered in the Reverse Rendering Method. In a DCS this facilitates the search for Specific Subject Entries in a short range of entries as in the case of the classified arrangement in the CCS.

52 Further Work

Having noted the above helpful feature of the Forward Rendering in Subject Heading, the work was extended to examine the following in particular:

1 Whether the Compound Subjects going with

11 Different Main Subjects can be brought together,

12 Different Non-Main Basic Subject of a particular Main Subject can be brought together,

13 Different Host Subjects with a particular Basic Subject can be brought together;

2 The facility to be provided for approach to a specific subject from the name of the components of the Compound Subjects going with a Basic Subject;

3 Methods of rendering the Heading of the General Subject Entry so as to facilitate selection of documents of interest to the reader at the moment in an economic way;

4 Methods of economy in making General Subject Entry without detracting from its utility in achieving objective 3 mentioned above; and

5 The inadequacies of the suggested method of formulating Subject Heading for a DCS.

53 Procedure

531 Selection of Documents and Facet Analysis

About 200 assorted subjects embodied in whole books (that is, macro document) going with different Basic Subjects were selected. Each subject was facet analysed according to the Method of Postulates from Step 0 to Step 5. The Title-in-Standard-Term arrived at Step 5 was used to formulate the Specific Subject Heading. The necessary and sufficient number of Generic Terms comprehending each of the Kernel Terms occurring in the Title-in-Standard-Term was interpolated in their respective places in the Subject Heading as decided by the Principles of Facet Sequence, specially the Wall-Picture Principle. The use of a Scheme for Classification facilitates this. We used the Freely Faceted version of the Colon Classification.

532 Heading for General Subject Entry

Other General Subject Entries were derived from the Heading of each Specific Subject Entry. These have the function of Subject Cross Reference Entry -- that is, directing the reader to the Specific Subject Entry. The cyclic permutation of terms in a Specific Subject Heading, as explained in an earlier paper (2) was used. Here is an example.-

Specific Subject Heading:-

AGRICULTURE, Tropics, Disease, Insect

Headings for the General Subject Entries derived from the above Specific Subject Heading:-

Insect./ AGRICULTURE, Tropics, Disease
Disease, Insect./ AGRICULTURE, Tropics,
Tropics, Disease, Insect./ AGRICULTURE

Each of the terms in the Specific Subject Heading that can constitute an approach term (that is, Sought Term) is made an Entry Word giving rise to a Heading for a General Subject Entry. A reader, after locating in the alphabetic arrangement the term denoting the Kernel Idea he has in mind, reads the Heading for the General Subject Entry starting from the term in capitals following a full stop and virgule. That would give him the Heading of the Specific Subject Entry. For example, if the readers term of approach is 'Insect' when the specific Subject of his interest is "Insect diseases in Tropical Agriculture", he would come across the Heading "Insect./ AGRICULTURE, Tropics, Disease". The Heading for the Specific Subject Entry is given by reading the above Heading for General Subject Entry as "AGRICULTURE, Tropics, Disease, Insect". The manner in which such Headings for Subject Entries are to be read and its advantages have been mentioned in the earlier paper (2).

533 Alphabetisation

The Specific Subject Entries and the General Subject Entries were arranged in a single alphabetical sequence by their Headings. A sample of the resulting catalogue is given in Sec 91.

534 CCS and DCS: Parallel Arrangement

A sample of fifty Compound Subjects going with the Basic Subject "Medicine" were selected. Each subject was assigned a Class Number according to Colon Classification. The entries were arranged in the classified sequence and a list prepared.

The Class Number and the corresponding Feature Heading were retained. The same set of entries were then rearranged alphabeticaly according to the Headings for the Specific Subject Entries prepared in the manner suggested in Sec 531. The two sets of entries were arranged in parallel columns to facilitate comparison (See Sec 92). The bibliographical details of the documents concerned are not given in the list. However, specimens of the Specific Subject Entry may be seen in the list in Sec 91.

6 OBSERVATION

61 Compound Subjects going with a Main Subject

In a CCS all the Compound Subjects going with a particular Main Subject will be brought together. It may be seen from the catalogue given in Sec 91 that the Compound Subjects going with the Main Subject "Agriculture", are brought together. So also is the case with the Compound Subjects going with each of the Main Subjects "Animal Husbandry", "Biology", "Botany", "Medicine", "Microbiology" and "Zoology".

62 Compound Subjects going with a Non-Main Basic Subject

In a CCS all the Compound Subjects going with a particular Non-Main Basic Subject of a Main Subject will be brought together. This implies that

1 All the Compound Subjects going with a System Basic Subject will be brought together.

It can be seen in column b of the Table given in Sec 92 that the Compound Subjects going with the

Systems Basic Subject "Ayurveda" are brought together.

2 All the Compound Subjects going with a Specials Basic Subject will be brought together.

It can be seen in column b of the Table given in Sec 92 that the Compound Subjects going with the Specials Basic Subject "Child Medicine" are brought together. So also is the case with the Compound Subjects going with each of the Specials Basic Subjects "Medicine of the Embryo" and "Female Medicine".

3 All the Compound Subjects going with a particular Canonical Basic Subject will be brought together. The suggested method of formulating Subject Headings will ensure this feature also in the DCS as it has done in the case of the Systems Basic Subject and the Specials Basic Subject.

63 Subjects going with a Host Subject

In a CCS all the subjects going with a particular Host Subject will be brought together. It may be seen in column b of the Table given in Sec 92, that the subjects going with the Host Subject "Medicine of Digestive System" are brought together; so also is the case with subjects going with each of the Host Subjects: "Disease in Medicine", "Medicine of Primary Sensory System", "Medicine of Eye", "Medicine of Respiratory System", "Medicine of Lung", and "Physiology of Lung".

64 Approach to Specific Subject Entry

641 Alphabetical Subject Index

The CCS provides an alphabetical index of subjects, to help the reader to

1 Locate in the Classified Part the entries for documents of specific interest to him at the moment; and

2 Land him in a region in the Classified Part such that he can locate the entries for documents of specific interest to him with the aid of the filiatory arrangement of the entries and the Feature Headings even if the term under which he looks up denotes an idea broader than the one about which he actually requires information.

This facility promotes efficiency in the reader-librarian-document finding system dialogue leading to a precise formulation of the reader's query.

642 General Subject Entry

The kind of Headings for the General Subject Entries to be derived on the basis of the Specific Subject Headings has been mentioned in Sec 532. Such a Heading provides for an approach to the Specific Subject Entries by the name of any one or more of the components in the name of the Compound Subject concerned. It will be remembered that the necessary and sufficient number of Generic Terms is introduced in each of the Specific Subject Headings (See Sec 531). As a result, an approach to the Specific Subject Entries by a term denoting a broader Kernel Idea is also facilitated. A reader is thus enabled to land in a region of the DCS where the Compound Subjects going with either a Main Subject, or a Non-Main Basic Subject, or even a Host Subject, as the case may be, will be found together within a short range of entries. This helps him to locate the entries for the documents of specific interest to him at the moment with comparatively greater ease than would be possible if the Heading for the Specific Subject Entries formulated according to the Reverse Rendering Method. Here is an example:

Let us suppose that the specific subject of interest to the reader at the moment is "Ecology of Fungus". He may look up in the catalogue under the term 'Ecology'. The following entries with 'Ecology' as the Entry Word occur in the catalogue:

Ecology./ BIOLOGY
Ecology./ BIOLOGY, Land
Ecology./ BIOLOGY, Polar
Ecology./ BOTANY, Thallophyta, Fungus
Ecology, Migration./ ZOOLOGY, Aves

Obviously, the reader will choose the fourth entry. According to the prescription given in Sec 532 the Heading of the General Subject Entry, will be read as 'BOTANY, Thallophyta, Fungus, Ecology'. This, in fact, is the Heading of the Specific Subject Entry under which he will find the entries for the documents on the specific subject of interest to him at the moment -- that is, "Ecology of fungus". It is possible that the reader may look up under the Entry Word 'Fungus'. He will then come across the following entry:

"Fungus, Ecology./ BOTANY, Thallophyta"

This is read as

"BOTANY, Thallophyta, Fungus, Ecology"

As in the preceding case, this will be the Heading of the Specific Subject Entry.

65 Choice of the Specific Subject Heading

651 Classified Catalogue System

Let us suppose that the specific subject of interest to the reader is "Carcinoma of Lung". Let us also suppose that in the CCS, he looks up the Alphabetical Part under the term "Tumour". The Heading of the Class Index Entry will be "Tumour, Lung Medicine". Against this will be given the Class Number L,45;472. He now looks up the Classified Part of the catalogue under this number. Of course, it is assumed that the reader will not conclude from the entry in the Alphabetical Part that the library has no documents on the subject "Carcinoma of Lung"! In the Classified Part all the entries for documents dealing with the varieties of "Tumours of Lung" will be brought together and arranged in a helpful sequence. The Feature Headings will help him in locating the entries for the documents dealing with the specific subject of his interest at the moment -- namely, "Carcinoma of Lung".

652 Dictionary Catalogue System

In the DCS, using the particular pattern of rendering the Heading of General Subject Entries suggested in Sec 532, the reader is helped in two ways by the General Subject Entries themselves to the same extent as that given by See also Subject Entries (3):

1 He gets specific information as to whether the library has a document or not on the specific subject of interest to him at the moment; and

2 He gets the Specific Subject Heading under which he will find the entries for the documents on the

specific subject of interest to him at the moment irrespective of the name of the component of the Compound Subject under which he looks up in the catalogue.

It is worth noting here that each of the General Subject Entries contains in itself the Heading of the Specific Subject Entry. This is not so in the case of the Class Index Entries of the CCS. And therefore, the reader cannot ascertain from the Class Index Entries whether the library contains a specific document on the specific subject of his interest at the moment. This issue has been dealt with in detail in the earlier paper (1). This element of uncertainty is practically eliminated in the DCS.

66 Economy in Making General Subject Entry

661 Current Practice

Consider the following Specific Subject Heading prepared according to the existing rules of Chain Procedure:

PHYSICAL METHOD,DIAGNOSIS, DISEASE, CHILD, MEDICINE.

The See also Subject Entries will be as follows:-

DIAGNOSIS, DISEASE CHILD, MEDICINE.
See also
PHYSICAL METHOD, DIAGNOSIS, DISEASE, CHILD, MEDICINE.

DISEASE, CHILD, MEDICINE.
See also
PHYSICAL METHOD, DIAGNOSIS, DISEASE, CHILD, MEDICINE.

CHILD, MEDICINE.
See also
PHYSICAL METHOD, DIAGNOSIS, DISEASE, CHILD, MEDICINE.

MEDICINE.
See also
PHYSICAL METHOD, DIAGNOSIS, DISEASE, CHILD, MEDICINE.

622 Suggested Method

According to the suggestion in this paper, the Specific Subject Heading for the example in Sec 661 will be formulated as follows:

MEDICINE, Specials, Child, Disease, Diagnosis, Physical method

The Heading of the General Subject Entries will be as follows:

Physical method./ MEDICINE, Specials, Child, Disease, Diagnosis
Diagnosis, Physical method./ MEDICINE, Specials, Child, Disease
Disease, Diagnosis, Physical method./ MEDICINE, Specials, Child
Child, Disease, Diagnosis, Physical method./ MEDICINE, Specials

663 Annotation

Between the two sets of entries given in Sec 661 and 662 respectively, there is practically no difference either in the number of entries or in the number of terms in an entry taken as a whole.

Each of the General Subject Entries given in Sec 662 is virtually a *See* Subject Entry having a function similar to that of a *See also* subject Entry given in Sec 661. Therefore, if a See Subject Entry is to be made according to the present practice using each of the Headings given in Sec 662 as the Referred-from-Heading, then the Specific Subject Heading is to be used as the Referred-to-Heading.

Example:

Diagnosis, Physical Method./ MEDICINE, Specials, Child Disease
See
MEDICINE, Specials, Child, Disease, Diagnosis, Physical method.

The particular pattern of rendering the Heading of a General Subject Entry prescribed in this paper obviates the need of mentioning the Referred-to-Heading.

7 SUMMARY OF FINDINGS

71 Increasing the Efficiency of the DCS

From the discussion in the preceeding sections it can be inferred that a number of the advantages of the classified part of the CCS can be built into the DCS by

1 Using the Title-in-Standard-Terms arrived at Step 5 in the Method of Postulates for Classifying, as the basis for formulating the Specific Subject Heading;

2 Interpolating in the appropriate positions in the Title-in-Standard-Term the necessary and sufficient number of "Generic Terms" as determined by the Wall-Picture Principle;

3 Using the Forward Rendering Method in rendering the Specific Subject Heading.

72 Help from General Subject Entry

The General Subject Entry is formulated in such a way that it helps the reader in the choice of the Heading for the Specific Subject Entry for documents likely to be most pertinent to his interest at the moment.

73 Inadequacy

With the method suggested here while it is possible for the DCS to make a closer approximation to the CCS, the former cannot still bring together the subject entries in a filiatory sequence as that achieved by the latter. For example, the entries for documents on Compound Subjects going with different Main Subjects will be scattered by the alphabetical make up of the name of the Main Subjects. A similar scatter occurs among coordinate isolate ideas of Compound Subjects going with one and the same Main Subject or Host Subject.

731 Example of Scatter by Main Subject

	Sequence in	
	Colon Classification	Alphabetical arrangement
B	Mathematic	Agriculture
C	Physics	Biology
D	Engineering	Botany
E	Chemistry	Chemistry
F	Technology	Economics
G	Biology	Engineering
H	Geology	Geology
I	Botany	History
J	Agriculture	Mathematics
K	Zoology	Medicine
L	Medicine	Physics
	... ...	
V	History	Political science
W	Political science	Technology
X	Economics	Zoology

732 Example of Scatter by Coordinate Isolate

	Sequence in	
	Colon Classification	Alphabetical arrangement
L;2	Medicine, Anatomy	Medicine, Anatomy
L;3	Medicine, Physiology	Medicine, Disease
L;4	Medicine, Disease	Medicine, Genetics
L;5	Medicine, Personal hygiene	Medicine, Personal hygiene
L;6	Medicine, Genetics	Medicine, Physiology

8 PROVISIONAL RULES FOR MAKING SUBJECT HEADING

81 Heading for Specific Subject Entry

811 Choice of Heading

1 The subject of the document is to be Facet Analysed according to the Method of Postulates, using Steps 0 to 5, as prescribed in the *Prolegomena* (7).

Note.- 1 In using the Method of Postulates, the General Theory of Classification as propounded in the *Prolegomena* (6) is assumed.

2 The Title-in-Standard-Terms arrived at in Step 5 is to be used for formulating the Specific Subject Heading.

812 Rendering

1 The descriptive labels affixed to the Kernel Terms in the Title-in-Standard-Terms are to be removed.

2 At the beginning of the Title-in-Standard-Terms the Main Subject Term is to be extrapolated if it is not already present.

3 The term 'Systems' or 'Specials', as the case may be, is to be interpolated between the Main Subject Term and the term denoting the Systems Basic Subject or that denoting the Specials Basic Subject.

4 The necessary and sufficient number of Generic Terms comprehending each of the Kernel Terms, other than a Basic Subject Term, are to be interpolated in their appropriate places as determined by the Principles for Facet Sequence.

Note.- In choosing the Generic Terms, a Freely Faceted Scheme for Classification, such as CC will be helpful. A thesaurus constructed on sound principles of classification can also be used for this purpose.

5 Each of the full stops between the Kernel Terms is to be replaced by a comma.

6 The sequence of the Kernel Terms, determined according to the rules given in the preceding categories of this section, is to be retained in rendering the Specific Subject Heading.

813 Style of Writing

1 The term denoting the Main Subject in the Specific Subject Heading is to be written in capital letters.

2 Each of the other terms, including the Main Subject Term in Phase 2 of a Complex Subject, in the Specific Subject Heading is to be written in ordinary hand with the initial letter capitalised.

3 A term denoting a Phase Relation is to be written in ordinary hand and underlined (italics in print).

4 An auxiliary term is to be written in ordinary hand.

82 Heading for General Subject Entries

821 Choice

1 The Specific Subject Heading is to be used as the basis for formulating the Headings of the General Subject Entries.

2 A General Subject Entry is to be prepared using as First Heading each of the Sought Terms, excepting the Main Subject Term, in the Specific Subject Heading.

822 Rendering

1 Each First Heading is to be followed by the other terms in the Specific Subject Heading as in a cyclic permutation.

823 Style of Writing

1 The Last Term in the Specific Subject Heading, occurring in each Heading of the General Subject Entry got by permutation, is to be successively followed by a full stop (.) and a virgule (/).

2 Other rules for the Style of Writing the Heading of a General Subject Entry will be the same as those given in Sec 813.

91 Catalogue

Africa./ ZOOLOGY, Aves, Natural history

AGRICULTURE, Disease, Therapeutics, Drug, Antibiotics
WOODBINE, Ed. Antibiotics in agriculture. 1963.
J;4:6391 N63

AGRICULTURE, Specials, Tropics, Disease, Insect
CASWELL. Agricultural entomology in the tropics.
1962. J9UA3;4-2T8 N62

Algae./ BOTANY, Specials, Water, Ocean, Thallophyta

Algae, Natural history, United States of America./ BOTANY, Specials, Water, Fresh Water

Anatomy./ ZOOLOGY, Nervous system

ANIMAL HUSBANDRY, Ruminant, Physiology, Metabolism
BLAXTER. Energy metabolism in ruminants. 1962.
KX,2Z;33 N62

ANIMAL HUSBANDRY, Ruminant, Rumen, Microbiology
HUNGATE. Rumen and its microbes. 1966.
KX,2Z,26T;(GX) N66

Anthropogeography, Migration, Bibliography./ GEOGRAPHY

Antibiotics./ AGRICULTURE, Disease, Therapeutics, Drug

Arthropoda, Insecta, Reproduction./ ZOOLOGY

Aves, Ecology, Migration./ ZOOLOGY

Aves, Natural, History, Africa./ ZOOLOGY

Bacteria, Genetics./ MICROBIOLOGY

Bacteria, Habitat, Soil./ MICROBIOLOGY

Bacteria./ TECHNOLOGY, Commodity production, Food, Meat and meat products, Spoilage

Bacteria./ TECHNOLOGY, Commodity production, Food, Spoilage

Bibliography./ GEOGRAPHY, Anthropogeography, Migration

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ODUM and ODUM. Fundamentals of ecology. Ed 2. 1968.
G; 5 N68

BIOLOGY, Genetics, Evolution application of statistical Calculus
MORAN. Statistical process of evolutionary theory. 1962. G;66&eBT N62

BIOLOGY, Specials, Land, Ecology
WADSWORTH, Ed. Measurement of environmental factors in terrestrial ecology. 1968.
G9UB;5 N68

BIOLOGY, Specials, Polar, Ecology
DUNBAR. Ecological developments in Polar regions etc. 1968. G9UA6Z;5 N68

BOTANY, Physiology, Metabolism, Nitrogen
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SMITH. Fresh water algae of the United States Ed 2. 1950. I9UK7,22:12.73 N50

BOTANY, Specials, Water, Ocean, Thallophyta, Algae,
BONEY. Biology of marine algae. 1966.
I9U97,22 N66

BOTANY, Thallophyta, Fungus, Ecology
ROBINSON. Ecology of fungi. 1967. K,23;5 N67

Carcinoma./ MEDICINE, Respiratory system, Lung Disease, Tumour, Malignant.

Commodity production, Food, Meat and meat products, Spoilage, Bacteria./ TECHNOLOGY

Commodity production, Spoilage, Bacteria./ TECHNOLOGY

Continuous./ MICROBIOLOGY, Culture

Continuous./ MICROBIOLOGY, Physiology influenced by Microbiology, Culture, Continuous

Culture, Continuous./ MICROBIOLOGY

Culture, Continuous./ MICROBIOLOGY, Physiology influenced by Microbiology

Culture./ ZOOLOGY, Specials, Embryo, Vertebrata

Drug, Antibiotics./ AGRICULTURE, Disease, Therapeutics

Disease, Insect./ AGRICULTURE, Specials, Tropics

Disease, Micro-organism, Tuberculosis./ MEDICINE, Respiratory system, Lung

Disease, Therapeutics, Drug, Antibiotics./ AGRICULTURE

Disease, Tumour, Malignant, Carcinoma./ MEDICINE, Respiratory system, Lung

Ecology./ BIOLOGY

Ecology./ BIOLOGY, Specials, Land

Ecology./ BIOLOGY, Specials, Polar

Ecology./ BOTANY, Thallophyta, Fungus

Ecology, Migration./ ZOOLOGY, Aves

Embryo, Vertebrata, Culture./ ZOOLOGY, Specials

Evolution application of Statistical calculus./ BIOLOGY, Genetics

Food, Meat and meat products, Spoilage, Bacteria./
TECHNOLOGY, commodity production

Food, Spoilage, Bacteria./ TECHNOLOGY, Commodity
production

Fresh water, Algae, Natural history, United States
of America./ BOTANY, Specials, Water

Fresh water, Vermes, Nemathelminthes, Nematoda./
ZOOLOGY, Specials, Water

Fungus, Ecology./ BOTANY, Thallophyta

Gasteropoda, Prosobranchiata, Natural history, Great
Britain./ ZOOLOGY, Mullusca

Genetics, Evolution application of Statistical calculus./
BIOLOGY

Genetics./ MICROBIOLOGY, Bacteria

GEOGRAPHY, Anthropogeography, Migration; Bibliography
MANGALAM. Human migration: A guide to migration
literature in English, 1955-1962. 1968.
U46 N68

Great Britain./ ZOOLOGY, Mollusca, Gasterpoda,
Prosobranchiata, Natural history

Habitat, Soil./ MICROBIOLOGY, Bacteriology

Insect./ AGRICULTURE, Specials, Tropics, Disease

Insecta, Reproduction./ ZOOLOGY, Arthropoda

Invertebrata, Nervous system./ ZOOLOGY

Land, Ecology./ BIOLOGY, Specials

Lung, Disease, Microorganisms, Tuberculosis./ MEDICINE,
Respiratory system

Lung, Disease, Tumour, Malignant, Carcinoma./ MEDICINE,
Respiratory system

Malignant, Carcinoma./ MEDICINE, Respiratory system,
Lung, Disease, Tumour

Meat and meat products, Spoilage, Bacteria./
TECHNOLOGY, Commodity production, Food

MEDICINE, Respiratory system, Lung, Disease, Microorganism, Tuberculosis
DUFAULT. Diagnosis and treatment of pulmonary tuberculosis. Ed 2. 1957. L,45;4-21 N57

MEDICINE, Respiratory system, Lung, Disease, Tumour, Malignant, Carcinoma
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Metabolism./ ANIMAL HUSBANDRY, Ruminant, Physiology

Metabolism, Nitrogen./ BOTANY, Physiology

Microbiology./ ANIMAL HUSBANDRY, Ruminant, Rumen

MICROBIOLOGY, Bacteria, Genetics
HAYES. Genetics of bacteria and their viruses, etc. Ed 2. 1968. G7,2;6 N68

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GRAY and PARKINSON, Ed. Ecology of soil bacteria. 1968. GT,2-5711 N67

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MALEK and FENEL. Theoretical and methodological basis of continuous culture of microorganisms. 1966. GT;18,3 N66

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MICROBIOLOGY, Physiology influenced by Microbiology, Culture, Continuous
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Microorganism, Tuberculosis./ MEDICINE, Respiratory system, Lung, Disease

Migration, Bibliography./ GEOGRAPHY, Anthropogeography

Migration./ ZOOLOGY, Aves, Ecology,

Mollusca, Gasteropoda, Prosobranchiata, Natural history, Great Britain./ ZOOLOGY

Natural history, Africa./ ZOOLOGY, Aves

Natural history, Great Britain./ ZOOLOGY, Mollusca, Gasteropoda, Prosobranchiata

Natural history, United States of America./ BOTANY, Specials, Water, Fresh-water, Algae

Nemathelminthes, Nematoda./ ZOOLOGY, Specials,
Water, Fresh-water, Vermes

Nematoda./ ZOOLOGY, Specials, Water, Fresh-water,
Vermes, Nemathelminthes

Nervous system, Anatomy./ ZOOLOGY

Nervous system./ ZOOLOGY, Invertebrata

Nitrogen./ BOTANY, Physiology, Metabolism

Ocean, Thallophyta, Algae./ BOTANY, Specials, Water

Physiology, influenced by Microbiology, Culture,
Continuous./ MICROBIOLOGY

Physiology, Metabolism./ ANIMAL HUSBANDRY, Ruminant

Physiology, Metabolism, Nitrogen./ BOTANY,

Polar, Ecology./ BIOLOGY, Specials

Prosobranchiata, Natural history, Great Britain./
ZOOLOGY, Mollusca, Gasteropoda

Reproduction./ ZOOLOGY, Arthropoda, Insects

Respiratory system, Lung, Disease, Microorganism,
Tuberculosis./ MEDICINE

Respiratory system, Lung, Disease, Tumour, Malignant,
Carcinoma./ MEDICINE

Rumen, Microbiology./ ANIMAL HUSBANDRY, Ruminant

Ruminant, Physiology, Metabolism./ ANIMAL HUSBANDRY

Ruminant, Rumen, Microbiology./ ANIMAL HUSBANDRY

Soil./ MICROBIOLOGY, Bacteria, Habitat

Spoilage, Bacteria./ TECHNOLOGY, Commodity production,
Food

Spoilage, Bacteria./ TECHNOLOGY, Commodity Production,
Food, Meat and meat products

Statistical calculus./ BIOLOGY, Genetics, Evolution
application of

TECHNOLOGY, Commodity production, Food meat products,
Spoilage, Bacteria
JENSEN. Microbiology of meats. 1954.
F8,53Za;4-24 N54

TECHNOLOGY, Commodity production, Food, Spoilage, Bacteria
TANNER. Microbiology of foods. 1944.
F8,53;4-24 N44

Thallophyta, Algae./ BOTANY, Specials, Water, Ocean

Thallophyta, Fungus, Ecology./ BOTANY

Therapeutics, Irub, Antibiotics./ AGRICULTURE, Disease

Tropics, Disease, Insect./ AGRICULTURE, Specials

Tuberculosis./ MEDICINE, Resporatory system, Lung, Disease, Microbrganisms

Tumour, Malignant, Carcinoma./ MEDICINE, Respiratory system, Lung, Disease

United States of America./ BOTANY, Specials, Water, Fresh-water, Algae, Natural history

Vermes, Nematheliminthes, Nematoda./ ZOOLOGY, Specials, Water, Fresh-water

Vertebrata, Culture./ ZOOLOGY, Specials, Embryo

Water, Fresh water, Algae, Natural history, United States of America./ BOTANY, Specials

Water, Fresh water, Vermes, Nemathelminthes, Nematoda./ ZOOLOGY, Specials

Water, Ocean, Thallophyta, Algae./ BOTANY, Specials

ZOOLOGY, Arthropoda, Insecta, Reproduction
DAVEY. Reproduction in the insects. 1965.
K,86;67 N65

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MATHEWS. Bird navigation. 1968.
K,96;58 N68

ZOOLOGY, Aves, Natural history, Africa
MOREAU. Bird faunas of Africa and its islands.
1966. K,96;12:6 N66

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ZOOLOGY, Nervous system, Anatomy
KRIEG. Functional neuroanatomy. 1966.
K,07;2 N66

ZOOLOGY, Protozoa, Physiology
HUNTNER. Biochemistry and physiology of protozoa. 1964. K,2;3 N64

ZOOLOGY, Specials, Water, Fresh-water, Vermes, Nemathelminthes, Nematoda
GOODEY. Soil and freshwater nematodes. 1963.
K9UK7,631 N63

92 Classified Sequence and Alphabetical Sequence

Classified sequence	Alphabetical Sequence
(a)	(b)
L"K-56-N Medicine, Encyclopaedia	MEDICINE, Anatomy
L;2 Medicine, Anatomy	MEDICINE, Anatomy bias to Medicine, Nervous system, Brain, Disease, Diagnosis, Physical Method, X-ray
L;2&bL,72;4:3,253 Medicine, Anatomy bias to Medicine, Nervous system, Brain, Disease, Diagnosis, Physical Method, X-ray	MEDICINE, Bone, Disease, Metabolism influenced by Medicine, Endocrine gland, Parathyroid, Physiology
L;4:3,2 Medicine, Disease, Diagnosis, Physical method	MEDICINE, Circulatory system, Heart, Disease in relation to Medicine, Female, Obstetrics, Pregnancy

Classified Sequence	Alphabetical Sequence
(a)	(b)
L;4:3,411 Medicine, Disease, Diagnosis, Pathology, Cell examination	MEDICINE, Digestive system, Esophagus, Disease
L;4:6 Medicine, Disease, Therapeutics	MEDICINE, Digestive system, Large intestine, Colon, Anatomy bias to Medicine, Disease, Therapeutics, Surgery
L;4-2 Medicine.Disease, Microorganism, Virus	MEDICINE, Digestive system, Liver
L;4-725:6,7 Medicine, Disease, Tumour, Malignant, Therapeutics, Organotherapy	MEDICINE, Digestive system, Mouth, Disease, Tumour, Malignant, Carcinoma
L;4-94:6 Medicine, Disease, Burn, Therapeutics	MEDICINE, Disease, Burn, Therapeutics
L;4-9B Medicine, Disease, Infectious	MEDICINE, Disease, Diagnosis, Pathological, Cell examination.
L,13Z;2 Medicine, Trunk, Anatomy	MEDICINE, Disease, Diagnosis, Physical method
L,15;4 Medicine, Thorax, Disease	MEDICINE, Disease, Infectious
L,17;2 Medicine, Neck, Anatomy	MEDICINE, Disease, Microorganism, Virus
L,18;2 Medicine, Head, Anatomy	MEDICINE, Disease, Therapeutics
L,187 Medicine, Head, Scalp	MEDICINE, Disease, Tumour, Malignant, Therapeutics, Organotherapy
L,21;4-7257 Medicine, Digestive system, Mouth, Disease, Tumour, Malignant, Carcinoma	MEDICINE, Encyclopedia

Classified Sequence	Alphabetical Sequence
(a)	(b)
L,23;3 Medicine, Digestive system, Esophagus, Disease	MEDICINE, Endocrine gland, Physiology bias to Medicine, Genetics, Reproduction
L,24;4-7257 Medicine, Digestive system, Stomach, Disease, Tumour, Malignant, Carcinoma	MEDICINE, Genito-urinary system, Bladder, Disease, Tumour
L,2722;2&bL;4:7 Medicine, Digestive system, Large intestine, Colon, Anatomy bias to Medicine, Disease Therapeutics, Surgery	MEDICINE, Head, Anatomy
L,291 Medicine, Digestive system, Liver	MEDICINE, Head, Scalp
L,32;4&aL9F;31 Medicine, Circulatory system, Heart, Heart, Disease in relation to Medicine, Female, Obsterics, Pregnancy	MEDICINE, Neck, Anatomy
L,4155 Medicine, Respiratory system, Nose, Sinus	MEDICINE, Nervous system, Anatomy
L,45;3:b6 Medicine, Respiratory system, Lung, Physiology, Measurement	MEDICINE, Nervous system, Disease, Structural, Injury, Supersensitivity
L,45;38&aL;4:3,1 Medicine, Respiratory system, Lung, Physiology, Respiration, in relation to Medicine, Disease, Diagnosis, Clinical method	MEDICINE, Primary sensory system, Eye, Disease, Functional disorder, Allergy
L,45;4-21 Medicine, Respiratory system, Lung, Disease, Microorganism, Tuberculosis	MEDICINE, Primary sensory system, Eye, Lens, Disease, Opacity: Glaucoma

Classified Sequence	Alphabetical Sequence
(a)	(b)
L,52;4-72 Medicine, Genito-urinary system, Bladder, Disease, Tumour	MEDICINE, Primary sensory system, Skin, Disease, Tumour, Malignant, Carcinoma
L,6;3&bL;67 Medicine, Endocrine gland, Physiology bias to Medicine, Genetics, Reproduction	MEDICINE, Respiratory system, Lung, Disease, Microorganism, Tuberculosis
L,7;2 Medicine, Nervous system, Anatomy	MEDICINE, Respiratory system, Lung, Physiology, Measurement
L,7;4-70Z;s298 Medicine, Nervous system, Disease, Structural, Injury, Supersensitivity	MEDICINE, Respiratory system, Lung, Physiology, Respiratory in relation to Medicine, Disease, Diagnosis, Clinical method
L,85;4-337 Medicine, Primary sensory system, Eye, Disease, Functional Disorder, Allergy	MEDICINE, Respiratory system, Nose, Sinus
L,853N;4-7112 Medicine, Primary sensory system, Eye, Lens, Disease, Opacity: Glaucoma	MEDICINE, Specials, Child, Disease, Functional disorder, Allergy
L,92;4-333&gL,64;3 Medicine, Bone, Disease, Metabolic influenced by Medicine, Endocrine gland, Parathyroid, Physiology	MEDICINE, Specials, Child, Newly born, Tissue, Anatomy
L9B;2 Medicine, Specials, Embryo, Anatomy	MEDICINE, Specials, Child, Primary sensory system, Eye, Disease, Functional disorder, Blindness
L9B;4:7 Medicine, Specials, Embryo, Disease, Therapeutics, Surgery	MEDICINE, Specials, Embryo, Anatomy

Classified Sequence	Alphabetical Sequence
(a)	(b)
L9B3,93Z;21 Medicine, Specials, Embryo, Foetus, Tissue, Anatomy, Microscopical	MEDICINE, Specials, Embryo, Disease, Therapeutics, Surgery
L9C;4:3,2 Medicine, Specials, Child, Disease, Diagnosis,Physical method	MEDICINE, Specials, Embryo, Foetus, Tissue, Anatomy, Miscroscopical
L9C;4-337 Medicine, Specials, Child, Disease, Functional disorder, Allergy	MEDICINE, Specials, Female, Genito-urinary system, Genital organ, Uterus, Cervix, Disease, Tumour, Malignant, Carcinoma
L9C0,93Z;21 Medicine, Specials, Child, Newly born, Tissue, Anatomy	MEDICINE, Specials, Female, Obstetrics, Labour, Operation, Forceps delivery
L9F;31:3 Medicine, Specials, Female, Obstetrics, Pregnancy, Diagnosis, Clinical method	MEDICINE, Specials, Female, Obstetrics, Pregnancy, Diagnosis, Clinical method
L9F;31&gL,32:4 Medicine, Specials, Female, Obstetrics, Pregnancy influenced by Medicine, Circulatory system, Heart, Disease	MEDICINE, Specials, Female, Obstetrics, Pregnancy influenced by Medicine, Circulatory system, Heart, Disease
L9F;3577 Medicine, Specials, Female, Obstetrics, Labour, Operation, Forceps delivery	MEDICINE, Specials, Industry, Respiratory system, Lung, Disease
L9F,551;4-7257 Medicine, Specials, Female, Genito-urinary system, Genital organ, Ovary, Disease, Tumour, Malignant, Carcinoma	MEDICINE, Specials, Tropical

Classified Sequence	Alphabetical Sequence
(a)	(b)
L9F,5533;4-7257 Medicine, Specials, Female, Genito-urinary system, Genital organ, Uterus, Cervix, Disease, Tumour, Malignant, Carcinoma	MEDICINE, System, Ayurveda, Digestive System, Large intestine, Appendix, Disease, Inflammation, Appendicitis, Therapeutics
L9UA3 Medicine, Specials, Tropical	MEDICINE, System, Ayurveda, Disease, Therapeutics
L9X,45;4 Medicine, Specials Industry, Respiratory system, Lung, Disease	MEDICINE, System, Siddha, Specials, Female, Disease
LB;4:6 Medicine, System, Ayurveda, Disease. Therapeutics	MEDICINE, Thorax, Disease
LB,27214;4-15:6 Medicine, System, Ayurveda, Digestive System, Large intestine, Appendix, Disease, Inflammation, Therapeutics	MEDICINE, Trunk, Anatomy
LC-9F;4 Medicine, System, Siddha, Specials, Female, Disease	

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SUBJECT HEADING AND DOCUMENT FINDING SYSTEM.

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The difficulties of pre-determined Subject Headings in their use, preparation, and maintenance are discussed, using LC Subject headings as the type. The identity of the first five steps in the systematic procedure for subject analysis, based on postulates, for the post-determination of Class Number and of Subject Heading is described. Examples are cited from the near-concurrence to this idea found in the British national bibliography, the partial-concurrence found in the Medical subject headings, and the divergence found in the LC Subject headings. Further problems awaiting pursuit in the improvement of the post-determination of Subject Headings are discussed in respect of the syntax of the ideas in the Forward Multiple Subject Headings and in the Reverse Multiple Subject Headings used for See Reference. The DRTC experiment in the possibility of removing the residual difficulties by the use of Indicator Digits is mentioned. Finally, the relative helpfulness in document finding systems, of the use of natural language and of classificatory language respectively for expressing Multiple Subject Heading is raised.

1 PRE-DETERMINED SUBJECT HEADING

The number of subjects in the Universe of Subjects is many times larger than the number of words in any preferred natural language. Further, the Universe of Subjects is continuously throwing forth new subjects. No natural language is able to create new words at an equal rate. Therefore, a Subject Heading other than a Basic Subject Heading has to contain many words or word-groups used respectively as Main Heading and successive Component

Headings. In other words, a Subject Heading has to be a Multiple Heading.

11 Number of Subject Headings

The number of Subject Headings to be included in a pre-determined list of Subject Headings has to be of the order of the number of subjects in the Universe of Subjects; indeed, it has to be very very large. Therefore, the LC Subject headings extends to 1,357 three-columned pages, each column having about 57 lines. There are nearly 50,000 Subject Headings besides an even larger number of auxiliary or reference entries. And yet, these cannot include the headings for the new subjects that will emerge continuously in the future.

12 Step for Economy

According to the introduction to the book, in order to effect a substantial saving in the number of Subject Headings listed, and to shorten their list, the names of the following categories have been omitted from the list:-

"1 Persons, with the exception of a few such as Lincoln, Napoleon, Shakespeare, Richard Wagner, and Washington;

2 Corporate bodies;

3 Places, when they form an integral part of other headings or are used in examples cited under some subjects, or when sub-divisions under them must be shown, as in the case of historical periods;

4 Lower natural groups in botany and zoology;

5 Individual chemical compounds;

6 Ships;

7 Religious bodies;
8 Special prayers; and
9 Individual deities."

13 Cost of Production

In spite of such large omissions, the time, the manpower, and the finance required to produce and publish periodical editions of such a Pre-determined List of Subject Headings are bound to be enormous.

14 Difficulty in Use

Apart from this, the use of such a massive, heavy volume of Subject Headings is by itself not easy. It is made even less easy by scope notes and reference notes of several kinds, occurring under several headings. For example, the following "Scope notes" and other reference notes occur under the heading, 'Civil Service':-

"Civil Service

"Here are entered works on career, government service, and the laws governing it. Works on government service, including that by political appointment or employment contract, are entered under the name of the country, state, or city, with the subdivision "officials and employees". Works on personnel of a specific government agency are entered under the name of that agency, with the sub-division "officials and employees"."

In addition to this, there are the following normal references under the same heading:-

"sa (= see also),

Administrative law	Bureaucracy
Application for office	Civil list

Civil service pensioners
Collective labour agreements
Misconduct in office
Municipal officials and employees
Public officers
Uniforms, Civil
Veterans-Employment

"*x* (= see),
Administration
Government employees
Office, Tenure of
Tenure of office

"*xx* (= refer from)
Administrative law
Bureaucracy
Political science
Public administration
Public officers"

There is also the following additional *See also* note:

"See also subdivisions
"Officials and employees -- Appointment, Qualifications, Tenure, etc
Under names of countries, *cities*, *etc*"

The cause for so many notes under a heading is the alphabetical scattering of related Subject Headings.

15 Procrustean Bed

In spite of the large number of Headings provided, the *LC Subject headings* forces many subjects into one or other of the Procrustean Beds -- Subject Headings -- provided by it. It is difficult to find among them coextensive Subject Headings even for many subjects at book-level -- not to speak of the level of micro subjects embodied in micro documents, such as articles in periodicals. In this connection, we have to remember that a micro subject of today often reaches the book-level tomorrow. The plight of newly formed subjects will be even worse. The Sear's list minimises the cost of production; but it drastically reduces the number of Procrustean Beds. Naturally, this reduces enormously the chance for coextensive Subject Headings.

16 Parallelism between Finding Subject Heading and Classifying

The defects of pre-determined Subject Headings are similar to those of a pre-determined Schedule of Subjects for use in classifying -- that is, using an enumerative scheme providing ready-made Class Numbers for all subjects. The rigidity and the inadequacy are of the same order in both the cases. In 1924, an attempt was made to replace enumerative classification by a scheme which

1 Facet-analyses each subject as and when it turns up;

2 Translates each facet-term into its facet-number; and then

3 Synthesises all the facet-numbers and thus forms the Class Number.

In other words, the Class Number of a subject is post-determined instead of being pre-determined. During the last forty years, the successive refinements of this method of post-determination of Class Numbers have been removing the residual elements of rigidity lurking in the method. Today we have reached the rigidity-free scheme of the post-determination of the Class Number of each subject, as and when it turns up. This is denoted by the term 'Freely Faceted Scheme for Classification' (10).

Similarly, we should replace the inadequate and rigid pre-determined list of Subject Headings by the post-determination of the Subject Headings of a subject as and when it turns up. This too can be done by a 'Freely Faceted Scheme for Subject Heading'. This method has not yet become widely known and popular. This is due to historical reasons and to the inertial resistance to any rethinking inherent in man.

2 AN EXPERIENCE OF 1948

21 Visit to the Library of Congress

In August 1948, I visited the Library of Congress for the first time. I was received with great kindness and given every facility to observe "the work behind the screen" in that library. I was amazed to find two large teams of staff working in two huge rooms -- one in fixing the Class Number of the new accessions, and the other in fixing the Subject Headings of the same. In essence, this meant doing the same task twice. Because, the objective of each of these two tasks is the same. In the evening, I was asked to address the members of the staff. I said in effect, "No country less rich than USA could afford the wastage of money involved in such a duplication of work. If it were left to me, I shall disband one of the teams!" Then came a pertinent plaintive remark from the floor, "Then we shall all lose our job!" (Laughter). "No", I said, "you will all be employed in the more enjoyable human work of reference service -- the work of helping every reader in an intimate and personal way in the choice of his books -- and derive supreme satisfaction from the gleam of satisfaction radiating from the eyes of the readers." A voice, "Thank God! We are safe."

22 First Version of Chain Procedure

Once the Class Number is fixed by the classification section by reading the book and doing every thing else necessary, the Subject Heading could be derived in no time from the Class Number with the aid of the Chain Procedure. The first version of this procedure for deriving Subject Heading from Class Number was published in 1938 (16). It was then shown that this procedure could be used also with the Decimal Class Number as the basis. At that time, I had not realised that the LC Class Number would not lend itself for use in Chain Procedure; because its make-up was not expressive of the subject represented by it. The LC Class Number denoted its subject only extentionally and not descriptively. Nor was this unsuitability of the LC Class Number raised by anybody in the audience. Even today because of the use of the LC Scheme for Classification, double expenditure in men, money, and time has to be perpetuated. When will rationalisation be done?

23 My Own Wrong Impression

In the early years, I was under the impression that the Class Number of the subject of a book should be fixed before its Subject Heading could be derived from it. This impression was due to the practical procedure followed and recommended in 1937 for classifying a book (9). The same wrong impression was perpetuated in another book in 1944 (7). This wrong impression was again reinforced in the same year in a book by K M Sivaraman (19).

3 EMERGENCE OF THE CORRECT VIEW

31 Foundation

The first foundation for the correct approach in the matter was laid in 1957 in terms of postulates for classification (10). This foundation was refined in 1958 (8).

32 Systematic Procedure for Subject Analysis

The refinement in the postulational approach to classification led to a systematic procedure for classification. A full account of this systematic procedure was given in 1962 (5).

4 GENERAL MISCONCEPTION

Even after the systematic procedure for classifying, without any dependence whatever on a predetermined facet formula, had been established, the implication of the systematic procedure for establishing the Subject Heading of a book without dependence on the Class Number was not realised for another two years. Some adverse writings on the British technology index started in 1962, disclosed a misconception about Facet Analysis. It implied the belief that Facet Analysis was either by itself classification or that it was a technique designed exclusively for classification. This is not correct. On the other hand, Facet Analysis can be used for three different purposes:-

1 Help in the construction of the Class Number of a document;

2 Help in the precise formulation of the subject requirement of a reader; and

3 Help in the construction of the Subject Heading of a document (14).

5 POST-DETERMINATION OF SUBJECT HEADING AND OF CLASS NUMBER

51 Systematic Procedure for Subject Heading

The systematic procedure for Subject Heading based on Postulates and Facet Analysis was demonstrated in 1964 (15). Let us take the following title published in the *British national bibliography* of 1965, with the accession number (B65-10239):-

"Rehabilitation following fracture of the femoral neck".

The following are the results in the successive steps of the systematic procedure in arriving at the Subject Heading for the document on the basis of the Postulates and Principles for Facet Sequence. In order to save space, the annotations and the explanations leading to each step from the preceding step have been omitted. They can be easily found by following the analogy from the examples worked out in the *Elements of library classification* (1962) and in the *Prolegomena to library classification* (1967) (11).

The following abbreviations are used in the example, from Step 3 onwards:-

(BS) = Basic Subject
[1E] = Round 1 Energy Facet
[1MP1] = Round 1 Level 1 Matter-Property Facet
[1P1] = Round 1 Level 1 Personality Facet
[1P2] = Round 1 Level 2 Personality Facet

Step 1: *Full Title*:- In Geriatrics, rehabilitation following the fracture of the femoral neck.

Step 2: *Title in Kernel Terms*:- Medicine (aged) Rehabilitation. Fracture. Bone. Thigh. Neck.

Note:- The composite term 'Femur' is not likely to be known to a generalist reader. Therefore, it is expressed in terms of its generally known constituent word-pair 'Bone (Thigh)'. For a similar reason, the term 'Geriatrics' is replaced by the word-pair 'Medicine (Aged)'.

Step 3: Analysed Title:- Medicine (Aged) (BS). Rehabilitation [1E]. Fracture [1MP1]. Bone (Thigh) [1P1]. Neck [1P2].

Step 4: Transformed Title:- Medicine-Aged (BS). Bone-Thigh [1P1]. Neck [1P2]. Fracture [1MP1]. Rehabilitation [1E].

Step 5: Title in Standard Terms:- It is same as the Transformed Title, since no term in it seems to require change into standard technical term.

We can now remove all the abbreviations denoting the status of each term according to the Postulate of Fundamental Categories. Then we get the following Subject Heading:-

"Medicine-Aged. Bone-Thigh. Neck. Fracture. Rehabilitation".

There is no need to go through the steps 6 and 7, construct the Class Number, and then come back to the Subject Heading already found in Step 5.

52 British national bibliography: Near-Concurrence

521 Subject Heading in the Classified Part

The British national bibliography is a classified catalogue. Therefore, the sequence of the component headings of a Subject Heading in the alphabetical part is the reverse of the sequence of the component headings in the corresponding Feature

Heading (= Subject Heading) in the classified part. The Feature Heading in the classified part reads as follows:-

Medicine. Hygiene and Diseases of the Aged.
Surgery. Femur. Neck. Fractures. Rehabilitation.

The Feature Heading is based on the scheme for classification given in Ed 14 (1942) of DC. There 618.97 represented 'Hygiene and Diseases of the Aged'. But in Ed 17 (1965) that number is shown to represent only 'Geriatrics' (= Medicine (Aged)). Therefore, the Feature Heading will get changed into:

Medicine (Aged). Surgery. Femur. Neck.
Fractures. Rehabilitation.

522 Exotic Term 'Surgery' in the Subject Heading in the Classified Part

Here the exotic term 'Surgery' persists in order to represent "r Surgery" in the Class Number "618.97 r Surgery". This is due to DC which, though it generally follows the Postulate of Facet Sequence, fails to do so in the Main Subject "61 Medicine". In fact, according to DC, "Step 4: Transformed Title" in the systematic procedure will read as follows:

Geriatrics (= Medicine (Aged)) (BS).
Surgery [1E]. Femur (= Bone (Thigh)) [2P1]
Neck [2P2]. Fracture [2MP1]. Rehabilitation [2E].

523 Removal of the Exotic Term from the Reverse Subject Heading in the Alphabetical Index

However, the exotic term 'Surgery' has been removed by the British national bibliography from the Reverse Subject Heading given to this book in its alphabetical part where, as already stated, the components of the Multiple Subject Heading are written in the reverse sequence. Here is that Subject Heading:

> "Rehabilitation: Fractures: Femoral Neck (= Neck; Femur (= Thigh (Bone)): Old people (= Aged)".

524 Omission of "Medicine" from the Subject Heading in the Alphabetical Part

Here, the heading "Medicine" has been omitted because it is implied in the last component heading "Old people". This omission is according to the Rules of Chain Indexing (2).

525 Near-Concurrence due to Systematic Procedure

Thus, subject to the aberration caused by the DC Number not following the Postulate of Facet Sequence, there is near-concurrence between the Multiple Subject Heading given in the *British national bibliography* and the one arrived at in Sec 51 of this paper by Systematic Procedure for Subject Analysis. This is, of course, due to the *British national bibliography* following the Systematic Procedure for the Post-Determination of Subject Heading.

53 Medical subject headings: Partial Concurrence

531 Multiple Subject Heading Provided

The Multiple Subject Heading for the subject mentioned in Sec 51 of this Paper, as derived from the *Medical subject headings* (V10,N1, Part 2; 1969, Jan of the *Index medicus*, National Library of Medicine, USA) is as follows:-

> "Femoral (= Bone-Thigh). Neck. Fractures. Rehabilitation".

The first three components of the Multiple Subject Heading are taken from Chap "C14 Injury, Poisoning and Immunology Disease" of the *Medical subject headings*. The last component of the Multiple Subject Heading "Rehabilitation" is taken from the list of sub-headings given in the "Introduction".

532 First Component: Its Omission

The first component of the Multiple Subject Heading given in Sec 51 of this Paper -- "Medicine (Aged)" -- has been omitted. However, if the Subject Heading of the book begins only with the term 'Femur', a homonym and a consequent ambiguity arise. For, the word 'Femur' may mean either "Bone (Thigh) of a human being" or "Bone (Thigh) of an animal such as a horse, or a dog, or cattle". It cannot be argued that the field of the *Index medicus* is restricted to the study of the human body alone, and that therefore the first heading 'Medicine' need not be written, but may be taken as understood. For, we find in its bibliography quite a number of articles on animals. Here are a few examples:

1 Stihl (H G). Fractures as an orthopedic problem in the sport horse (Schweiz arch tierheilk 110:309-19, Jan 68 (Ger)), listed in P 367 of V10, N1, Part 1 of the *Index medicus*;

2 Davis (P E). Fractures of the sesamoid bones in the grey-hound (Aust vet j. 45;15-9, Jan 69), listed in P 230 of V10, N5 of the *Index medicus*; and

3 Knosel (H). Cerebral necrosis in fattening calves (Deutsch tieraerztl wschr 75;237-43, 15 May 68 (Ger)), listed in P 193 of V10, N1, Part 1 of the *Index medicus*.

6

533 Resolution of the Homonym

To resolve this homonym, it is necessary to include the word-pair 'Medicine (Aged)' as the first component of the Multiple Subject Heading. The authority for this is found obliquely. The word 'Geriatrics' is listed in Chap "C2 Health Occupations". At the same time, there appears to be no instruction whether the word 'Geriatrics' may or may not be used as a component of a Multiple Subject Heading. Therefore, freedom is taken to take advantage of the benefit of doubt.

54 LC Subject headings: Divergence

541 Incompleteness

The LC Subject headings is incomplete. For the subject mentioned in Sec 51 of this paper, at first sight, we are likely to pick up the following Subject Heading:

"Femur — Fracture."

This Subject Heading is not complete.

542 Spotting out the word 'Rehabilitation'

A further scanning of the LC Subject headings helps us to spot out the word 'Rehabilitation'. Under this, as heading we find the following long note:

"Rehabilitation

"Here are entered general works on the physical, medical, psychiatric, and educational methods of restoring persons to normal activity. Works on rehabilitating specific groups of persons are entered under specific headings, with subdivision Rehabilitation, etc. eg

Amputees-Rehabilitation, etc, Blind-Rehabilitation, etc.

"Rehabilitation, Rural.
"Rehabilitation centres.
"Rehabilitation of criminals.
"Rehabilitation of the tuberculous. See Tuberculous-Rehabilitation, etc.
"Rehabilitation of war disabled. See Disabled-Rehabilitation, Etc".

This list being alphabetical, it naturally mixes up the slight differences in the connotation of the word 'Rehabilitation'.

543 Spotting out Positive Entries

The last two entries mentioned above come near to our rescue. But each of them is only a See Reference Entry. These lead to the following two positive entries:

"Disabled-Rehabilitation, etc."
"Tuberculous-Rehabilitation, etc."

There appears to be no instruction in the LC Subject headings whether or not the above two positive entries are meant to be samples on the analogy of which, the word 'Rehabilitation' can be used "as the last component of a Multiple Subject Heading."

544 Benefit of Doubt Helps

Assuming that the analogy may be followed, we obtain the following Multiple Subject Heading for the subject mentioned in Sec 51 of this paper:

"Femur (= Bone (Thigh))-- Fracture--Rehabilitation".

545 Incompleteness Persists

The Multiple Subject Heading, arrived at in Sec 543, is still incomplete. For, it lacks the following three components:

'Neck', 'Aged', 'Medicine'; and even the word 'Geriatrics' as a composite word to denote the last word-pair 'Medicine (Aged)'.

1 The word 'Neck' is used in the LC Subject headings to denote only the regional organ "Neck". Therefore, we cannot insert the word 'Neck' after the word 'Femur' to indicate "Femoral neck".

2 As explained in Sec 532, the word 'Femur' may denote the "Femur of a human body" or the "Femur of an animal body". It is thus a homonym. To resolve this homonym, the word 'Medicine' should be inserted as the first component of the Multiple Subject Heading. But there appears to be no direction to this effect in the LC Subject headings.

3 Looking for the word 'Aged', we do not get any help from any entry except "Aged--Care and Hygiene". This word-group cannot be fitted into the Multiple Subject Heading of the subject given in Sec 51 of this paper.

4 Under the heading "Aged--Care and Hygiene", we get also the See also reference to "Geriatrics". When we turn to the entry "Geriatrics", we find the See also reference to "Aged -- Care and Hygiene"(!) This entry serves hardly any purpose. But against the word 'Geriatrics' itself, we find mention of "(RC952-954)". This number is the LC Class Number for "Geriatrics" in the volume Classification: R Medicine (Ed 3, reprinted in 1960) of the Library of

Congress. From this, we do not get any help to solve our problem. Thus we draw blank at every turn.

546 Co-Extensive Subject Heading not Found

In spite of its forbidding size, the Pre-Determined List of LC Subject headings is of no use in getting coextensive Subject Headings for many subjects. There is divergence from the Complete Subject Heading needed.

6 PROBLEMS FOR PURSUIT

60 Post-Determination of Subject Headings: Right Method

Pre-Determined Subject Headings should be given up for the subjects in an ever-growing, ever-extending and ever-deepening -- Universe of Subjects. Post-Determination of Subject Headings by a systematic procedure for Subject Analysis, founded on Basic Normative Principles, such as the Postulates given in the Prolegomena to library classification (1967), and demonstrated in Sec 51 of this paper, can go a long way in the establishment of coextensive Subject Headings. To say this does not mean that the last word has been said on Subject Headings. Many residual problems do persist.

1 Difficulties are caused by synonyms in the verbal plane.

2 When a reader approaches the catalogue with most of his mind tied up with his own problem of pursuit, he may bring up to the catalogue any one of the component words in the Multiple Subject Heading concerned; and yet he must be helped to enter the catalogue through that component word and then

to reach at the correct Multiple Subject Heading answering his requirement.

3 The totality of Subject Headings forms a jargon of the natural language used, with its own distinctive syntax different from the syntax of the natural language to which its words belong.

4 The syntax of the Reverse Multiple Subject Heading in which the words are arranged in reverse sequence -- is the opposite of the syntax of the normal Forward Multiple Subject Heading.

5 In a subject of great depth, demanding Multiple Subject Headings with several components, further difficulties arise.

61 See References from Synonyms

The existence of synonyms will lead a reader seeking information about an idea, to look for it in the catalogue under any of the synonyms denoting that idea. To meet this situation, the catalogue uses in its Positive Subject Heading one of the synonyms as the standard word for the heading of the Positive Entry. From every synonym, it should, strictly speaking, give a See Reference to the word actually chosen for the Positive Subject Heading. A number of such See Reference Entries from every synonym of the preferred word of each entry will overflood the catalogue with such See Reference Entries. In fact, it would amount to reproducing several items from a dictionary. Judgment is therefore necessary in restricting the number of See Reference Entries to as few as possible (18). This problem is common both to the Pre-Determined Subject Headings and to the Post-Determination of Subject Headings. The service of the Reference Librarian can develop a helpful habit in readers, so as to minimise the number of See Reference Entries.

62 See References from Reverse Multiple Subject Heading

To help a reader, who brings up to the catalogue any word of the Multiple Subject Heading other than the first one, to reach at the correct full Subject Heading -- such as the one given in Sec 51 of this paper -- the following See References are necessary:

1 Rehabilitation. Fracture. Neck. Bone (Thigh). Medicine (Aged). See

Medicine (Aged). Bone (Thigh). Neck. Fracture. Rehabilitation.

2 Fracture. Neck. Bone (Thigh). Medicine (Aged). See

Medicine (Aged). Bone (Thigh). Neck. Fracture.

3 Neck. Bone (Thigh). Medicine (Aged). See

Medicine (Aged). Bone (Thigh). Neck. Fracture.

4 Bone (Thigh). Medicine (Aged). See

Medicine (Aged). Bone (Thigh).

It may be asked whether item 4 is necessary. The answer is 'Yes'. For, we can have the Subject Heading 'Horse (Aged). Bone(Thigh)' for which the reverse See reference heading should be "Bone (Thigh). Horse (Aged)". The annual volumes of the British technology index have effectively popularised the use of this kind of reverse See Reference Entries arising out of a Multiple Subject Heading.

63 Syntax of Forward Multiple Subject Heading

631 Syntax Determined by Inflexional Forms and Apparatus Words

The presence of inflexional forms or of apparatus words or punctuation marks or any other symbol or other words following the first component or any other component of a Multiple Subject Heading creates a problem in alphabetisation, which causes much difficulty to the reader in the use of an alphabetical list of such headings. This difficulty may be minimised to some extent if the role and the ordinal value of each punctuation mark are defined. This principle appears to be neglected by the LC Subject headings. Here is an illustrative tabular statement of the entries with a word denoting the idea "Medicine" as the first heading:

SN	First Word		Entries		
	Form	Word	N of	Beginning with	Ending with
1	Adjective	Medical	83	Medical assistants	Medical Zoology
2	Nominative Singular	Medicine	1	sa Anatomy	xx Pathology
3	-do-	Medicine followed by "—" (dash)	43	Medicine-Abbreviations	Medicine-⎡Period⎦ Jews
4	-do-	Medicine followed by " , " (comma)	38	Medicine, Ancient	Medicine, Veterinary
5	-do-	Medicine followed by apparatus word, symbol, or some other word	8	Medicine and art	Medicine shows
6	Nominative Plural	Medicines	4	Medicines, Antagonism of	Medicines, Specific
		Total Number of Entries	177		

Surely, any reader -- particularly a busy reader -- would prefer to have a better and more helpful organisation of the list of these 177 entries.

632 Avoidance of Inflexional Forms and Apparatus Words

To avoid this difficulty, it is necessary that no component of a Multiple Subject Heading is in inflexional form or has a qualifying apparatus word such as a preposition preceding or following it. Each component in a Multiple Subject Heading should be in its nominative singular form (3;17). Even in the case of a verb, it should be reduced to the form of a gerandial noun. Then a Multiple Subject Heading will form a sequence of nouns in nominative case, singular form.

633 Syntax of Position: Multiple Subject Headings form a "Jargon"

To get the meaning of a Multiple Subject Heading made of a sequence of nouns in singular form, the use of the ordinary Linguistic Syntax is not available. We have to depend entirely on the Syntax of Position. Thus, though the component words of a Multiple Subject Heading are taken from a natural language, the totality of these headings do not form a natural language. On the other hand, they form a special "jargon" of the natural language. Their jargon-status arises out of their syntax. Their Syntax of Position is the same as the Syntax of Facet Sequence. In this facet sequence, there is in general, a gradual movement from the most concrete idea denoted by the first component heading, towards the least concrete idea denoted by the last component heading. There are postulates on this subject. It has been conjectured that the Syntax of Facet Sequence is the same as Absolute Syntax -- that is, that syntax of ideas, which is found helpful and natural by a majority of readers -- not unduly influenced by the Linguistic Syntax of their respective mother languages (13).

64 Syntax of Reverse Multiple Subject Heading

In the case of a Reverse Multiple Subject Heading used as the heading of a See reference, the syntax is the reverse of what it is for a normal Forward Multiple Subject Heading. In other words, in a Reverse Multiple Subject Heading, the syntax is the reverse of the Syntax of Facet Sequence. In this sequence, the gradual movement is, in general, from the least concrete idea denoted by the first component heading towards the most concrete idea denoted by the last component heading of the Reverse Multiple Subject Heading.

65 Difficulties in Some Multiple Subject Headings

When the number of components in a Multiple Subject Heading is large, and even otherwise in a few cases, the interpretation of the Multiple Subject Heading gives some difficulties. This has been brought to light while making the documentation list of micro documents, such as articles in periodicals, being practised at present by the Research Team of the DRTC (Bangalore).

651 Resolution of Homonyn

Some of the difficulties have been traced to homonyms in the verbal plane. These can be avoided by resolving homonyms.

652 Insertion of Indicator Digit in Front of each Component in a Forward Multiple Subject Heading

In the case of residual difficulties, if any, some experiment is being made to see if they can be removed if the Indicator Digit used for the facet-numbers in Class Numbers are also used for the components of a Multiple Subject Heading. Let us give an example with the Multiple Subject Heading of the subject mentioned in Sec 51 of this paper. There, in "Step 4: Transformed title", the descriptive symbol after each component of the Multiple Subject Heading will be removed and the Indicator Digit appropriate to the succeeding component heading, (as prescribed in Colon Classification) (4), will be inserted in its place. The result will be:

"Medicine (Aged), Bone-Thigh, Neck; Fracture: Rehabilitation."

Further investigation is necessary to determine the desirability and the usefulness of this practice.

653 Insertion of Indicator Digit after each Component of a Reverse Multiple Subject Heading

As a consequential step, Indicator Digits should also be inserted in the Reverse Multiple Subject Heading used in See Reference. Here, the Indicator Digit appropriate to a component heading will be placed after it, instead of before it. Thus the Reverse of the above-mentioned Forward Multiple Subject Heading will be:

"Rehabilitation: Fracture; Neck, Bone-Thigh, Medicine (Aged)".
See
"Medicine (Aged), Bone-Thigh, Neck; Fracture: Rehabilitation".

7 NATURAL LANGUAGE VS CLASSIFICATORY LANGUAGE FOR SUBJECT HEADINGS .

Even when alphabetical subject headings are Post-Determined, their alphabetical sequence is not as helpful as it can and should be to a busy subject-specialist who comes to the catalogue with most of his mind tied up with the investigation being pursued by him. To him, the alphabetical scattering is a handicap, if not an irritation. His approach to the catalogue is in most cases subject-approach. Moreover, if he is working in the wave-front of knowledge, and looks for information on a nascent idea, the natural language may not have an agreed term to denote that nascent idea. He will, therefore, find it difficult to locate the entries he needs. On the other hand, if the Subject Heading is expressed in a classificatory language -- that is, in Class Number -- and its meaning is added after it in natural language in the form of a Feature Heading (= Multiple Subject Heading), then the systematic helpful succession of the Subject Headings according to their filiatory sequence will enable the reader to decide what exactly he wants and to pick up the entries on it. No doubt, such a sequence of subject entries arranged in classificatory language will not be directly intelligible to the reader. He can enter the catalogue only through its alphabetical part with the word that he brings to it. Because he has to use the alphabetical key, it is improper for the library profession to condemn him to find out what he wants by turning through the meanderings and chaos created by the alphabetical arrangement of the entries on all the subjects. On the other hand, it is the duty of the library profession to help that reader to find out, from the word he brings up to the catalogue, the particular region of the classified part containing his precise subject. Once he lands in that region, the helpful filiatory panaroma of the subject entries giving the name of each subject both in Class Number and in the natural language, will help him to determine the particular precise subject he is seeking and to make use of the documents entered under it, and perhaps also on the closely related subjects mentioned on either side of it. The discussion of this question really amounts to the discussion of the relative values of a classified arrangement of Subject Headings and an alphabetical arrangement of the same. A discussion of this here will throw this paper out of focus. But it has been discussed elsewhere with a number of examples (1;6).

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LIBRAMETRY AND ITS SCOPE.

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The term 'Librametry' was coined in 1948 at the Aslib Conference of the year in Leamington Spa. Illustrations of the use of the Elements of Statistical Calculus are given in the determination of the strength of the library staff in the disposition of the circulation and the reference staff during the different hours of the day, in the organisation and development of national and state library systems, in the distinction between service libraries and dormitory libraries, and in the design of library buildings. Illustrations are also given in the use of operations research in the transfer of a big library from one building to another without closing the library to the public, and in the periodical changes in the sequence of the subjects in the stackroom to help the fulfilment of Law 3 of Library Science. Some illustrative areas are given for the application of librametry in library techniques such as book selection, classification, cataloguing, and in the use of electronic Doc-Finder. Lastly, the inclusion of the Elements of Statistical Calculus in the curriculum for library science is considered.

1 GENESIS OF THE TERM 'LIBRAMETRY'

In September 1948, I was working in Manchester as a member of the Faculty of the International Summer School on Public Libraries, conducted by Ifla and Unesco. During that period, I received an invitation from the Aslib to attend its Annual Conference on 18 September 1948 at Leamington Spa. On account of delay of the train, I reached the Conference rather late. Mr Henri LeMeister, the

President of the Aslib, was in the chair and somebody was in the middle of his speech. It referred to library statistics now and then. LeMeister asked me to sit by his side on the platform and also to give my views on that speech. Unfortunately, I did not know the name of the speaker, nor the theme of his address in full. LeMeister furnished me with the necessary information. To my great delight and surprise, the speaker was Dr Bernal, with whose work I was familiar. The term 'Librametry' came out for the first time in my remarks on Professor Bernal's speech (2). I said that many of the matters connected with library work and service involved "large numbers". Therefore, as the saying goes, the wood could not be seen on account of the trees. However a calculus had been developed to deal with phenomena involving "large numbers", in an incipient form in the nineteenth century and in full vigour in the twentieth century. That is Statistical Calculus. It had been already in use in diverse disciplines. Karl Pearson had introduced the term 'Biometry' early in the present century. The study of economics with the aid of statistical calculus had given rise to the term 'Econometry'. So also we have the term 'Psychometry'. It is necessary for us librarians to develop 'Librametry'. The Chairman and many of the members of the audience welcomed this suggestion. At the end of the meeting, Professor Bernal and myself rested for an hour on the sunny lawn of the Conference House, discussing the potentiality of Librametry.

11 Earlier Practice of Librametry though without that Name

Though the term 'Librametry' was coined by me only in 1948, I had been practising the application of the elements of statistical calculus to library problems since 1925. This was because I learnt statistical calculus when I was a student of mathematics during 1914 to 1916, and I had been continuing its study since then. After I began to teach mathematics, the erratic vicissitude in the percentage of successful candidates in the examination from year to year was the first to engage my thought. Professor P V Seshu Ayyar and myself collaborated in 1921 in going into this problem, on the basis of the marks-registers for the Intermediate examinations from 1911 to 1921, maintained by the University of Madras. We arrived at a formula for removing the annual idiosyncracies, in terms of standard deviation and average (13). It was later considered by the Hartog Committee on Examinations. After I became librarian in 1924, I saw many possible uses of the elements of statistical calculus in the day-to-day working of libraries, in the organisation of a library system, and in the development of library techniques. I also began to practise it.

2 LIBRAMETRY IN THE DAY-TO-DAY WORK OF A LIBRARY

21 Strength of Staff

From 1925, the number of volumes added and the number of visitors to the Madras University Library, and the number of volumes used in a year, went on rising steadily. The curve of growth was fairly steep (5). The steepness began to slacken only after 1936. The procurement of sanction for the additional staff necessary to cope with the increase of work, was a difficult affair. It was a matter of annual fight with the authorities. However, I was keeping detailed statistical data about the man-hours needed in a year for each item of work in the library. In 1947, when I was invited by the Indian Institute of Science (Bangalore) for advice on staff requirements, these statistical data enabled me to evolve a detailed staff-formula based on work-load and not on mere guess or sentiment (8). This staff formula based on statistical data was found to be of help in several other libraries. The Library of the International Labour Office and the Library of the Swedish Railways were among them. In 1958, the University Grants Commission of India adopted this formula (16). This has given relief to many libraries in the country. With the help of the modern facilities for time and motion study, the constants of the staff formula can be verified and fixed with precision.

22 Disposition of Staff

Another problem encountered in the Madras University Library in the earlier years was providing just the adequate staff -- neither in excess nor in defect -- in the Circulation and the Reference Sections, during different periods of the day. For this purpose, hourly statistics were maintained, from 1925 to 1930. An analysis of these figures brought out unerringly the pattern of the distribution of the density of work during the different periods of the day. This helped us to organise the hours of duty of the members of the Circulation and the Reference Sections in an efficient and equitable way. For example, from 7 to 10 am, one person was sufficient in each Section; from 10 am to 7 pm, two persons were necessary in the Circulation Section; from 10 am to 4 pm, two persons were necessary in the

Reference Section; from 4 pm to 7 pm, three persons were necessary in it; and from 7 pm to 8 pm, one was sufficient in each Section. This disposition of the staff increased their productivity.

3 LIBRAMETRY IN THE ORGANISATION OF NATIONAL OR STATE LIBRARY SYSTEM

31 Viability of Independent Library Authority and of Rural Library

While writing my Library development plan for India (7) in 1950, I had to press into service the demographic and the financial statistical data to formulate a plan about population clusters and areas that would be viable to be made independent library units. A norm was also established for the viability of the minimum population of a locality to have a branch library. In the light of the increase in the cost of books and in staff salary during the last twenty years, the size of the viable units had to be increased. But in the establishment of branch libraries in the rural area, political and sentimental considerations often lead to uneconomical decisions. For example, under its Public Libraries Act (1948), the Tamil Nadu (Madras State) had 1,057 rural branch libraries at the end of the year 1966 (1). By now, it has increased still further. But statistical considerations would limit the number of such branch libraries to 802 (15). If only the concerned people had a statistical sense and used it to arrive at decisions objectively, this would have been avoided.

32 Librametry in Relation to Service Libraries and Dormitory Libraries

In the past, each library was actuated by a hoarding sentiment. It often prided itself in the number of volumes it had. Law 1 of Library Science -- "Books are for use" -- was not acted upon (4). Nor were the authorities guided by the wise advice of our National Poet Rabindranath Tagore that "What makes a library big is not its size but its use" (3). Hardly any library kept statistical data about the number of years for which a book continued to be of use. I kept such data in the Madras University Library for about twenty years. A good percentage of books went out of use in five years; a smaller percentage in ten years; and most of the books in twenty years. In the case of works of lasting value, new editions were brought out from time to time. Copies of such books in a library are usually worn out by legitimate use in about ten to twenty years; and they have to be replaced by new editions. If each library holds on to all the books that once got into it, it increases the cost of building and of maintenance without any real advantage. On the other hand, librametry would suggest that libraries should be grouped into service libraries and dormitory libraries. On the recommendation of its Documentation Committee, of which I was Chairman, the Indian Standards Institution, recommended in 1960 an upper limit for service libraries. For example, for a university library, according to its size, the upper limit recommended was 100,000 to 300,000. When the University of Calcutta applied for grant of a few millions of rupees to erect a new library building, so as to hold nearly a million volumes, a delegation of the Library Committee of the University Grants Commission, of which I was Chairman, went to the University for local enquiry. The Vice-Chancellor, Professor Siddhantha, and the University Architect (an Englishman) readily saw the wisdom in the indication of librametry and agreed that the volumes with a low and vanishing frequency of use -- not used even once in three years -- should be accommodated in a dormitory library in an easily accessible place well outside the city area, so that any of its books occasionally wanted may be brought over for use. But a professor insisted that all its 300,000 or 400,000 volumes were in active use; and that none of the books could be sent out to the dormitory collection. Thereupon, the members walked through the stackroom. The British architect put his little finger on the tops of the books in several places. The dust was a few millimeters' deep! This proved how unhelpful sentiments thrive, when a librametric sense is not developed.

33 Librametry and the Design of Library Building

Apart from the stackroom, the size of the reading room requires attention in the design of a library building. Each room -- be it a general reading room or a periodicals reading room or research reading room or a set of cubicles -- has to be designed so as to accommodate readers during peak hours. In this, I got some ideas from the Probability and its engineering uses (1928) by Thornton C Fry. To decide the accommodation needed during peak hours, careful hourly data of the number of occupants should be kept and the trend should be determined. We kept such data in the Madras University Library from 1925 to 1933. By a forecast on the basis of these data, the size of the general reading room and of the periodicals reading room needed for about ten years was determined. Provision was also made for the other rooms to be brought into use in due course. The other rooms, that were not needed for immediate use by the library, were occupied by the University Office. By 1939, the two reading rooms in actual use by the Library were getting full on Sundays and other holidays. But, thereafter, the unexpected World War II reduced the number of readers. If the library had the anticipated normal growth in its readers, the other rooms occupied by the University Office should have been taken over by the Library for its use.

4 OPERATIONS RESEARCH IN LIBRARY WORK

41 Transfer of Library from One Building to Another

In 1936, the Madras University Library had to be transferred from its temporary place in the Senate House to its new buildings. It was the ambition of the staff not to close the Library to effect the transfer, except perhaps on the day of formal opening. To carry out this ambition, the method of Operations Research was adopted. The books were all bundled in units 1.5 feet high. Each bundle had a slip on its top. On it were entered the inclusive call numbers of the books in the bundle, the exact shelf plank into which the bundle will go in the new building, and also the number of books in the bundle likely to be in demand during the interim period, and, therefore, withdrawn from it. These withdrawn books were in open book-racks, as usual, in the old building, for use by readers. About a month before the opening of the new building, about 5,000 bundles had been gradually transferred to the new building in the sequence of the decreasing probability for the use of any book in that bundle. In the last three days, many of the books in current use also were transferred to the new building. With a band of volunteers brought by Sri S Chandrasekharan, then an honours undergraduate and now Union Minister for Public Health and Family Planning, all the 1,200 bays in the new stackroom had been fitted with bay guides in advance. Thus, it was possible to keep the Library closed only for ten hours on the opening day. Even on that day, the Library functioned for three hours after the opening.

42 Periodical Rearrangement of the Subjects in the Stackroom

It was found that Law 3 of Library Science -- "Every Book its Reader" -- could be better satisfied by a periodical reshuffling of the subjects in the stackroom. This reshuffling had to be done when the library was working in full swing and without any extra place for the temporary housing of the books in any subject. Here again, the paper work done on Operations Research was of help in the rearrangement of the subjects without any difficulty or confusion or inconvenience to readers.

5 LIBRAMETRY AND BOOK SELECTION

The subject-scatter of book selection and the subject allotment of book-fund are important factors in book selection. With the help of the histograms showing these two factors for each of a few years of the past and of what can be conjectured about the changes likely to disturb in the immediate future, the proportion suggested by these histograms, the problem is solved objectively, and with greater reliability than if it is done with unaided conjecture (6). This was of much help in the Madras University Library. In the use of the histograms, some weightage or correction may have to be applied to some of them with circumspection. Two instances of this precaution are worth mentioning. It was found that psychology and education showed the highest frequency of use. This raised some doubt and to the detailed examination of the kind of books that were issued in these two subjects. It was found that the Psychology of sex by Havlock Ellis and the bound volumes of university question papers swelled the frequency of use in the two respective subjects. Therefore the frequencies in these two subjects had to be modified.

6 LIBRAMETRY AND CLASSIFICATION

61 Absolute Syntax and Facet Syntax

One of the vital problems in library classification is the decision of the most helpful sequence of the Personality, Matter, Energy, Space, and Time facets in a compound subject. On the basis of flair and experience, I had formulated certain postulates in this matter. One of the postulates will arrange the facets in the sequence mentioned above. It is worth verifying the validity of the helpfulness of this postulate objectively. In my Valedictory Address to the Symposium on the "Foundation of Syntactic Relations in Classification" held in the University of Maryland in June 1966, I had suggested a statistical method of determining the Absolute Syntax, if any, governing the sequence of facets of the subject inherent in the human intellect-in-action as it is today. Then the helpfulness or otherwise of the facet syntax given by my postulate can be decided upon. This investigation should be made by a team of specialists in Epistemology, Psychology, Linguistics, Reference Service, Design of Classification, and Statistical Calculus (11). I had also suggested the precaution that should be taken in carrying out this investigation. The final findings by statistical calculus will enable the classificationist to base the design of classification scheme on a fairly firm foundation. The present wastage in discussing the problem based on opinions and sentiments can be avoided. I even suggested that this piece of work and statistical investigation should be provided for by a Foundation.

62 "Long and Short" of Class Number

621 Book Level

A trivial amusing opinion was rampant for a few years after the publication of Colon Classification in 1933. It was generated and believed by naive "arm-chair" librarians that the Colon Class Number was much longer than the Decimal Class Number at the book level. In 1935, the question was statistically examined (14). The finding was as follows (9):

SN	Statistical Constants	CCN	DCN
1	Mode (most frequently occurring number of digits)	3.00	5.00
2	Median (number of digits which is not exceeded by half of the class number)	4.00	5.00

SN	Statistical Constant	CCN	DCN
3	Mean (the average number of digits in the class numbers)	4.80	5.80
4	Standard deviation (a measure of the spread of the range of the length of notation)	2.40	1.70
5	Correlation co-efficient between CC and DC.	0.56	

The above figures speak for themselves about the great risk or grave mistake of mere opinion while dealing with large numbers. Further, the difference in the standard deviations of the Colon Class Numbers and of the Decimal Class Numbers carried a message. The Colon frequency curve is much more spread out and graduated than the Decimal frequency curve. In other words, the Colon Class Number imitates more closely the variation of the "intension" of the subjects than the Decimal Class Numbers. The latter leans towards artificiality. The steepness and the narrowness of the Decimal Frequency Curve showed that the Decimal Class Numbers are unnaturally crowded within a narrow range of five digits.

622 Article Level

Again, in 1967 a similar statistical comparison was made of Colon Class Numbers and the Universal Decimal Class Numbers at the level of articles -- that is, depth classification. The finding was as follows (10):

SN	Statistical Constant	CC	UDC
1	Mode	12	18
2	Median	12	17
3	Mean	12	18

The above table shows that the average number of digits in UDC Numbers is fifty per cent more than that in the CC Numbers.

7 LIBRAMETRY AND CATALOGUING

A library catalogue is a permanent record. Its value depends upon the consistent sequence of the entries. This depends upon the headings of entries being consistently chosen and rendered. This, in its turn, depends upon rigorous cataloguing rules. On the other hand, when I learnt cataloguing in 1924, in the University College (London), the Cataloguing Code used was the Anglo-American Code of 1908, which was far from being rigorous. The students would give different choices of heading and even for the same heading different renderings. The lecturer used to say that any of these different choices and renderings might be used. This was a puzzle to me. By 1934, I had designed a fairly rigorous Catalogue Code -- the Classified catalogue code, now in its fourth edition. Some librarians criticised that that Code had gone into too many details and had denied freedom to individual cataloguers! I had to meet this criticism by having recourse to statistical calculus. I mentioned about ten factors which enter into the establishment of the catalogue entries for a book. If the rules allow freedom to every cataloguer to adopt his own style, the number of styles possible was shown to be 1,024. Therefore, the probability for consistency among the catalogue entries would be only one in 1,024, because a succession of cataloguers would contribute the entries in them, each following his own style. It is, therefore, impracticable to maintain uniformity of entries in a library catalogue and the catalogue of a growing library can hardly escape becoming a hotchpotch sooner or later (12). This finding of statistical calculus appears to have made some impact on the Anglo-American Code. For, its Edition 3 (1967) has more rigour than its Edition 1. And yet, it is not as rigorous as it should be; I attribute this to the statistical sense not having been brought to bear on the problem.

8 SAMPLING

Catalogue entries and class numbers have to be tested for their accuracy. The question is whether hundred per cent revision is necessary or a sample revision would prove sufficient. Here, it should be the former. For, a mistake even in one class number or in one catalogue entry will cause difficulties. On the other hand, hundred per cent inspection will be unnecessary and too expensive and, therefore, sampling of lots will be sufficient in finding out the problems such as the period of active use of books or the opinion of readers about the efficiency of library service. In the cases where sampling is sufficient, how should the lot for sampling unit, the sampling plan, the sampling efficiency, and the sampling error, be determined? These problems have to be investigated and guiding principles should be established on the basis of a guide such as the Manual on basic principles of lot sampling published by the Indian Standards Institution as its publication IS:1548-1960, or some similar manual. This problem of sampling arises in many other areas of library work.

91 LIBRAMETRY AND ELECTRONIC DOC-FINDER

Another new problem has recently arisen. This has been caused by the "Wonder Sense" induced in the majority of librarians by electronic engineering. In the first flush of wonder, there is a tendency in the members of the library profession to swallow everything claimed by electronic engineering, even to the point of abdicating or minimising their own effort in classification and cataloguing. The problem of the extent to which the work of an electronic doc-finder would depend upon a sound system of classification and cataloguing, the minimum work-load necessary to make the electronic doc-finder viable, the amount of noise and leakage should be investigated by statistically controlled experiments. The Cranfield experiment was the first of its kind. But it did not use a good individualising scheme for classification and cataloguing. The experiment should be repeated with a good scheme for classification and cataloguing and in conformity to the principles of sampling.

92 STATISTICAL CALCULUS IN LIBRARY SCIENCE CURRICULUM

The above are only examples of areas in library work leading themselves to the use of librametry. I am sure that a careful search will disclose more areas. We should consider from this point of view the desirability of acquainting librarians under training with the basic ideas of statistical calculus, the statistical outlook, and the statistical awareness. In my teaching of library science during the last forty years, I had always given a statistical flavour, as it were, in the exposition of many problems. Is this sufficient or is it desirable or necessary to give a few formal lessons on the Elements of Statistical Calculus biased to library practice and library science? This can be best done only by a teacher who is proficient in library science and has some knowledge of statistical calculus or by a person proficient in statistical calculus and has the necessary knowledge of library science. Otherwise, the course is likely to become lopsided and forbidding. The time has come to decide this issue.

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LAWS OF LIBRARY SCIENCE AND CHANGE IN WORK STANDARD.

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Law 4 of Library Science -- Save the time of the reader and of the library staff -- demands: (1) Reduction in variety of materials used and in the methods of doing routine and repetitive work, (2) Work simplification, and (3) Work standardisation. Law 5 of Library Science -- Library is a growing organism -- emphasises the dynamic and changing context in which library work is done. Change in the attributes of a component or of a component itself of a system may necessitate modification and adaptation of an existing standard, or the formulation of a new one. Based on a survey of one thousand books, data are presented on the pattern of incidence of certain cataloguing features in books published during the period 1925-1968. Using graphs and the techniques of least squares and analysis of variance, it is shown that the incidence of (1) Single Personal Authorship is decreasing with time; and (2) Two Joint Personal Authorship, Corporate Authorship, Collaborator, and Series is increasing with time and significantly so in the Natural Sciences. There is need to modify any standard set up some years ago for the number of books to be catalogued by a person in a given period. To maintain earlier performance standard, the methods of cataloguing may have to be changed, or additional hands will have to be utilised. Since there appears to be a predictable trend in the increase of the number of books presenting complexities for cataloguing, the work standard for cataloguing should be reviewed at suitable intervals of time.

1 NEED FOR STANDARD

11 Guiding Principle

The Law of Parsimony is a General Normative Principle stressing the need for economy in work. In library work, the correlate to this general principle is Law 4 of Library Science -- Save the time of the reader and that of the library staff. One source of wastage in library work is in having a variety of materials and/or a variety of ways of doing a job, when the variety could be conveniently reduced to one or a few kinds. This is particularly the case with routine and repetitive work. Therefore, one method of reducing the wastage due to the existence and use of several ways of doing a job is to formulate and implement a work standard (2).

2 NEED FOR CHANGE OF STANDARD

21 Guiding Principle

The Law of Parameter is a General Normative Principle stressing the need for modification or replacement of an existing practice with respect to the changes occurring in any of the components in the system concerned (1). Law 5 of Library Science -- Library is a growing organism -- reminds the librarian that he is working in a dynamic context. It implies that the attributes of the factors or the factors themselves associated with the different items of work in a library are likely to change. In turn, this implies that a standard formulated to guide a particular library work has to be reviewed at appropriate intervals of time and changes incorporated, if necessary, in consonance with the changing context. Only through such adaptation and change of the standard can the use of it be made productive, and the work done according to it, satisfy the Law of Parsimony in general and the Law 4 of Library Science in particular.

22 Frequency of Change

The change in the attributes of a component or of the components themselves may be slow and gradual in one system; it may be rapid and even sudden in another system, or even at different points of time in one and the same system. Between the two extremes there can be various gradations of the rate of change. Therefore, the frequency of review and revision of standard is likely to vary from one system to another.

3 SCOPE OF THE PAPER

1 Data is presented to show the change in the incidence of different cataloguing features in books over a period of time;

2 In particular, it is attempted to show that there is today a larger proportion of books presenting complexities in cataloguing than was the case in the past;

3 There is a difference in the incidence of the cataloguing features in books in the Natural Sciences on the one hand and the Humanities and Social Sciences on the other;

4 To use simple statistical techniques to test the significance of the findings; and

5 To describe the procedure adopted in the study, illustrating some of the managerial aspects of working in a team.

4 PROCEDURE

40 Steps in the Work

The work was done as a cooperative project by six DRTC trainees. It was apparent that without each of the participants clearly understanding the purpose of the work and the systematic procedure to be followed, there will be no consistency in the work, and will lead to wastage of effort. Therefore, to begin with, it was found helpful to outline the procedure to be followed. This was done in a group discussion by the members of the team. The steps followed and the sequence in which they were done are mentioned below:

1 Laying down the objectives of the investigation;

2 Decision on the library from which samples for the study are to be chosen;

3 Decision on the kind of data to be collected;

4 Laying down the procedure for collecting data;

5 Pilot study;

6 Modification of procedure, if necessary;

7 Assembly, organisation, and presentation of data;

8 Analysis of the data using statistical techniques; and

9 Making inference.

41 Laying Down Objectives

The objectives of the investigation were stated as follows:

1 To examine whether there has been an increase over the years in the proportion of the books presenting complexities for cataloguing; and

2 To examine the difference, if any, in the rate of change of the complexity in cataloguing features in the books in the field of the Natural Sciences on the one hand and those in the field of the Humanities and Social Sciences on the other.

42 Library to be Used

The survey of the cataloguing features of books in the field of the Natural Sciences was done in the Library of the Indian Institute of Science, Bangalore, covering the Basic Subjects A to L. The survey of the books in the field of the Humanities and the Social Sciences was done in the State Central Library, Bangalore, covering the Basic Subjects N to Z. This would serve the two objectives mentioned in Sec 41.

43 Decision on the Data to be Collected

Factors taken into consideration:- Our studies on the structure and development of the universe of subjects and of the factors leading to the development of documentation, have indicated that solo-research and paralle-research are being replaced in an increasing measure by team-research and research-in-series respectively. It was conjectured that this change could give rise to an increase in the number of books

1 With Multiple Personal Authorship;
2 With Corporate Authorship;
3 With Collaborators; and
4 Included in a Series.

If this could be established, then we may infer that a larger proportion of the books published nowadays would present complexities in cataloguing as compared to those published in the past. Therefore, it was decided to collect data on the following cataloguing features of a book:

1 Authorship
  Personal
  Corporate
2 Collaborator; and
3 Series.

It was also agreed among the participants to use the definition of each of the above terms as given in the Classified catalogue code, Ed 5 (1964).

44 Procedure for Collecting Data

441 Proforma

The headings in the proforma used for the collection of data were as follows:

1 Personal author
1.1 Single
1.2 Two
1.3 Three
1.4 More than three
2 Corporate author
5 Collaborator
8 Series

Annotation.- It may be noted that the serial numbers of the headings in the above proforma do not run consecutively. The reason is as follows. We had earlier completed another project on the study of the cataloguing features presented by about 500 books. In that work, we had formulated certain headings in a proforma used in the collection of data. Each of us had become very familiar with the notation of the headings in that proforma. It was therefore thought helpful to use the same notation in the proforma for the present work, lest it should lead to some confusion.

442 Division of Subject-Field

The collection of books to be examined was divided among the participants such that each got two to four subject-fields. For example, one person surveyed the books in Mathematics and Physics, another person, Engineering, Chemistry, and Chemical Technology; a third person the Biological Sciences; and so on.

443 Number of Books Selected

Each participant collected data on approximately 160 books. The books were picked up one after the other in the sequence in which they were found on the shelves -- that is, in the classified sequence. Care was taken to ensure that one and the same book was not selected more than once. It was assumed that this procedure was not likely to introduce any bias in the collection of the data.

444 Record of Data

The data about each book was recorded on a 75 x 125 mm slip (See Sec 46 for specimen).

45 Pilot Study

In order to ensure that the participants clearly understood the procedure to be followed and that in designing the proforma all the factors involved were taken into consideration, a pilot study was done. Each participant collected and recorded data about a few books available in the DRTC Library.

46 Modification

Reviewing the data collected in the pilot study, it was found that

1 The year of publication of each book should also be recorded; and

2 That this information should be placed as the very first line in the record, to facilitate sorting the entries year-wise later.

Here is a specimen of a record (data slip) according to the proforma finally agreed upon.

1967
1.2/
8/

47 Assembly and Organisation of Data

1 The data slips were first grouped into two categories:

1 Data slips giving information about books in the Natural Sciences; and

2 Data slips giving information about books in the Humanities and the Social Sciences.

2 The data slips for the books in the Natural Sciences were divided among three participants, each

getting about 165 entries. Similarly, the data slips for the books in the Humanities and the Social Sciences were divided among the other three participants. Thus, there were six sets of data slips.

3 The data slips in each set were arranged in a chronological sequence according to the year noted at the top of the record.

4 For each year, the total number of books selected was noted; the number of books presenting each of the cataloguing features mentioned in the proforma (See Sec 44) was tally-marked. A table was designed to present the data collected. Such a table of data was prepared for each of the six sets of data slips. Here is a specimen of the table:

Year	Total N	1.1	1.2	1.3	1.4	2	5	8
1933	4	2	1	–	–	1	1	2
1934	6	4	2	–	–	–	2	3
1935	10	7	2	1	–	–	3	5
...	...	...	...	...	...	...	...	...

5 The data from each of the six tables was consolidated. It was then found helpful to group the data into 5-year periods, beginning from 1899. The data for books in the Natural Sciences and those for books in the Humanities and the Social Sciences were kept separate and consolidated separately.

5 DATA

Tables 1 and 2 give details of the data on the cataloguing features for the books in the field of Natural Sciences and Humanities and Social Sciences. Data prior to 1924 are not presented because of the smallness of the samples.

51 Table 1. Consolidated Data

HS = Humanities and Social Sciences. NS = Natural Sciences.

Period		N of books		1.1 Single Personal Author				1.2 Two-Joint Personal Authors				1.3 Three-Joint Personal Authors			
				N of books		%		N of books		%		N of books		%	
N	Year	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS
1	1925-29	29	24	23	22	79.3	91.6	4	2	13.8	8.3	2	-	6.9	-
2	1930-34	30	34	17	27	56.6	79.4	10	1	33.3	2.9	1	-	3.3	-
3	1935-39	19	38	13	36	68.4	94.7	5	1	26.3	2.6	-	-	-	-
4	1940-44	43	27	33	27	76.7	100.0	4	-	9.5	-	1	-	2.3	-
5	1945-49	55	39	40	37	72.7	94.9	8	2	14.5	5.1	-	-	-	-
6	1950-54	42	42	28	41	66.7	97.6	7	-	16.7	-	1	-	2.4	-
7	1955-59	50	41	30	39	60.0	95.1	13	2	26.0	4.9	2	-	4.0	-
8	1960-64	91	59	55	55	61.9	93.2	21	3	23.0	4.0	-	-	-	-
9	1965-68	97	82	57	77	58.8	93.9	19	2	19.6	2.4	5	-	5.2	-

(Continued)

51 Table 1. Consolidated Data (Continued)

Period		N of books		2 Corporate Author				5 Collaborator				8 Series			
				N of books		%		N of books		%		N of books		%	
N	Year	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS
1	1925-29	29	24	-	-	-	-	7	2	15.2	8.3	10	3	43.5	12.5
2	1930-34	30	34	2	1	6.7	2.9	6	3	20.0	8.8	12	4	40.0	11.8
3	1935-39	19	38	-	1	-	2.6	2	3	10.5	7.6	5	4	26.3	10.5
4	1940-44	43	27	5	-	11.6	-	6	4	14.0	14.8	6	1	14.0	3.7
5	1945-49	55	39	7	-	12.7	-	13	5	23.6	12.8	7	2	12.7	5.1
6	1950-54	42	42	5	1	11.9	2.3	11	5	20.8	11.9	13	4	31.0	9.5
7	1955-59	50	41	4	-	8.0	-	9	11	18.0	26.8	14	2	28.0	4.9
8	1960-64	91	59	13	1	14.2	1.7	30	7	33.0	11.8	33	7	28.7	11.8
9	1965-68	97	82	13	3	13.4	3.7	52	16	53.6	19.5	39	7	41.1	8.5

52 Table 2. Summarised Data

Total Number of books = 988
Natural Sciences (NS) = 500
Humanities and Social Sciences (HS) = 488

Cataloguing Element	NS		HS	
	N of Books	%	N of Books	%
1 Personal Author				
1.1 Single ..	331	66.2	451	92.4
1.2 Two-joint ..	98	19.6	15	3.1
1.3 Three-joint ..	14	2.8	..	..
1.4 Four-joint ..	8	1.6	6	1.2
2 Corporate Author	49	9.8	16	3.3
5 Collaborator	140	28.0	67	13.7
8 Series ..	144	28.8	51	10.5

6 VISUALISATION AND ANALYSIS OF DATA

60 Period Studied

The figures in Sec 63 to Sec 67 visualise the data on the different cataloguing features in the form of graph (curve). The data represented are for the period 1940 to 1968. The reasons for the choice of this period are as follows:

1 The number of books selected in each of the earlier years was comparatively small;

2 For the period earlier to 1940, the curve representing each of the cataloguing element was found oscillatory;

3 The trend in almost all the curves becomes fairly steady after 1940; and

4 It was also conjectured that it was during

and after the Second World War, that cooperative team work in research, production, etc, became a prominent feature; and therefore,

5 It may even be possible to predict for the next few years on the basis of the trend observed in the period 1940-1968.

The 5-year periods were numbered as follows:

Years		Number
1940-44	..	1
1945-49	..	2
1950-54	..	3
1955-59	..	4
1960-64	..	5
1965-68	..	6

61 Test of Trend

611 Technique of Least Squares

The trend represented by each curve was studied using the technique of least squares. A regression line was fitted for each curve, using an equation of the form

$$X = \alpha + \beta p \quad \text{where}$$

X is the variable -- that is, the percentage incidence of a particular cataloguing feature such as Single Personal Author, Collaborator, and Series, depending upon the curve under consideration,

p the period; and
α and β constants.

The estimate of β, that is, $\hat{\beta} = \frac{S_{xp}}{S_{pp}}$

$$\hat{\beta} = \frac{\sum_{i=1}^{n} x_i p_i - \left\{\sum_{i=1}^{n} x_i \sum p_i\right\}/n}{\sum_{i=1}^{n} p_i^2 - \frac{\left(\sum_{i=1}^{n} p_i\right)^2}{n}}.$$

612 Table 3. Points On the Regression Line

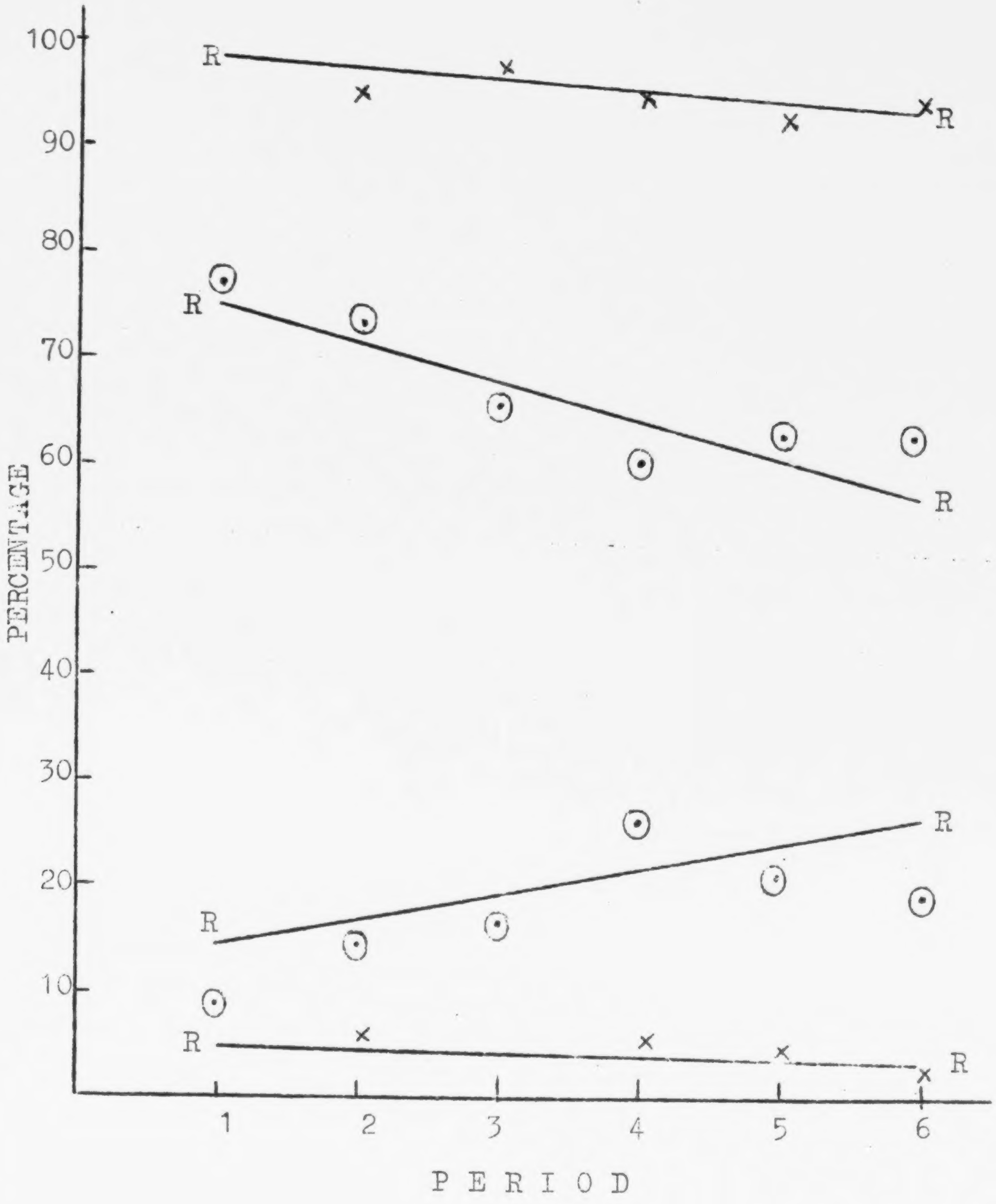
p	1.1		1.2		2		5		8	
	NS	HS	NS	HS	NS	HS	NS	HS	NS	HS
1	75.3	98.4	14.3	4.9	11.3	2.3	11.2	13.7	13.0	4.4
3	67.9	96.3	19.2	4.3	11.8	2.5	24.0	15.8	23.3	6.6
6	56.9	93.1	26.5	3.3	12.6	2.8	43.1	18.8	39.0	10.0

62 Notation Used

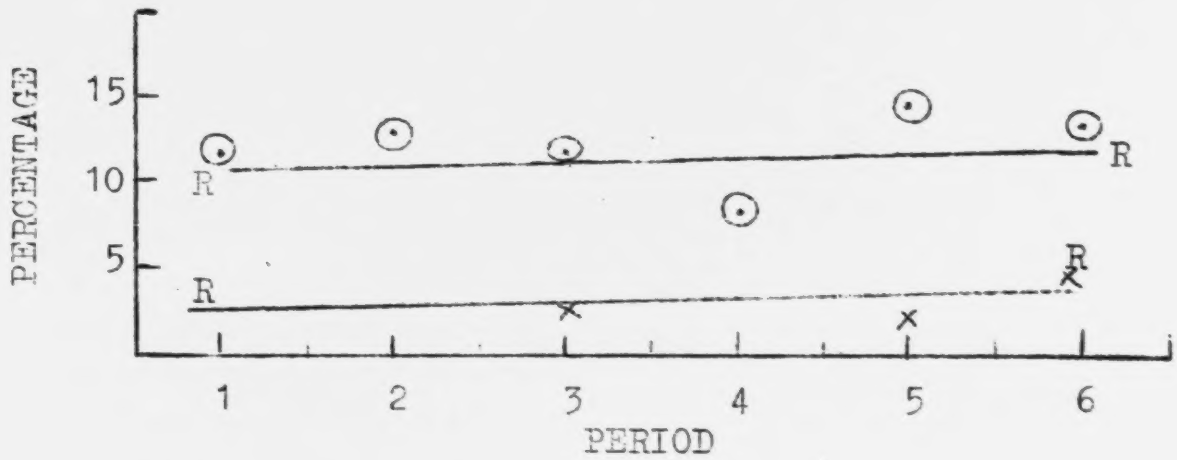
In each of the figures, the following notation has been used:

1.1	Single Personal Author
1.2	Two-Joint Personal Authors
2	Corporate Author
5	Collaborator
8	Series
x x x	Humanities and Social Sciences
⊙ ⊙ ⊙	Natural Sciences
R—R	Regression Line

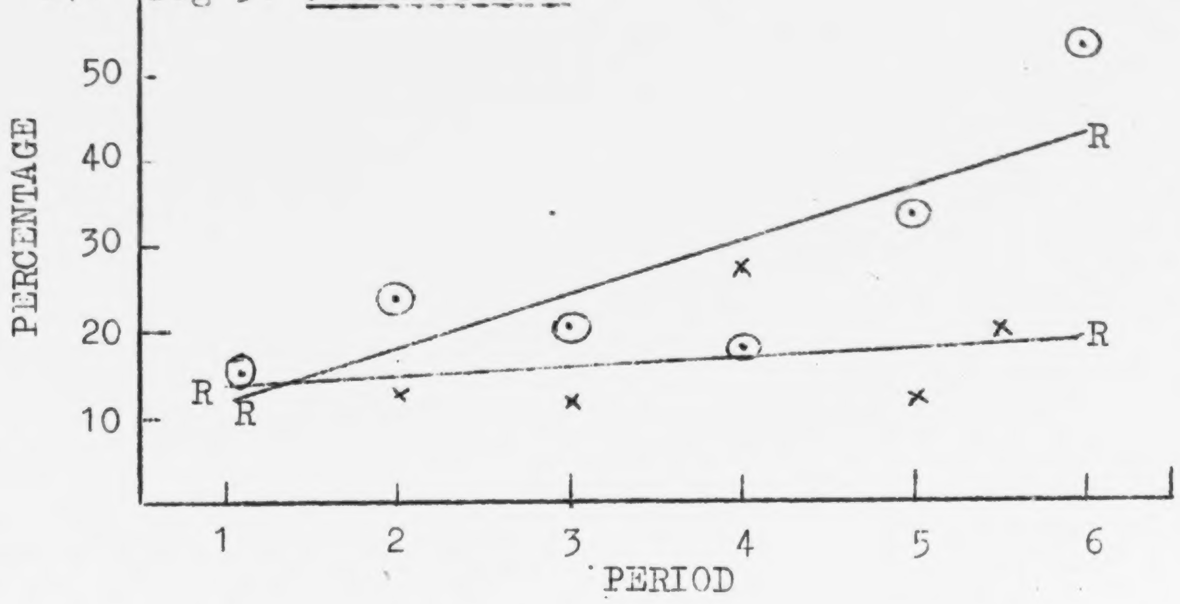
631 Fig. 1. Personal Authorship.



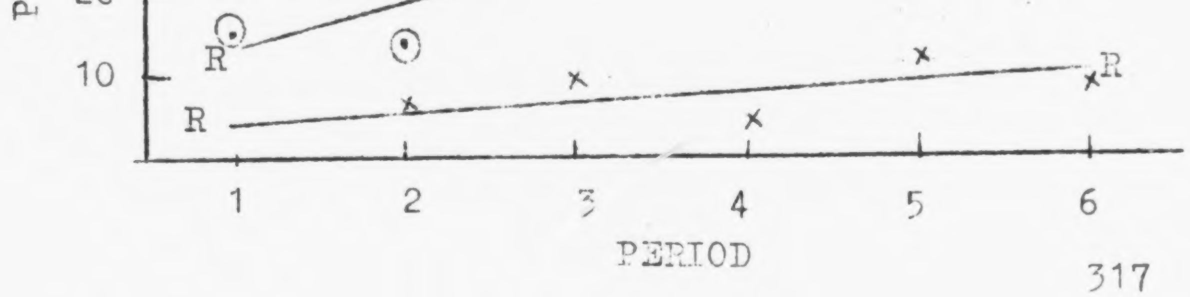
641 Fig 2. Corporate Authorship



641 Fig 3. Collaborator



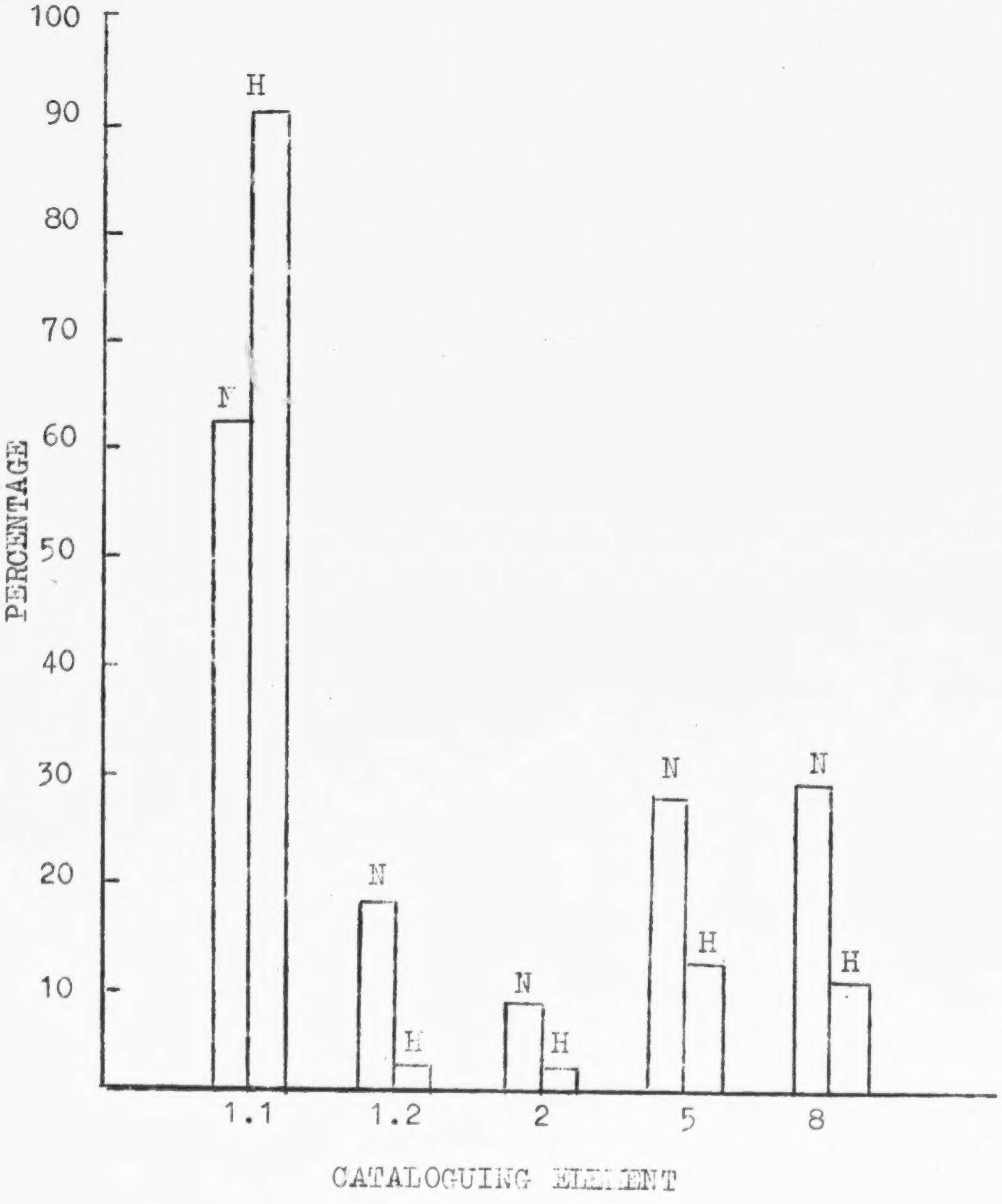
661 Fig 4. Series



671 Fig 5. Comparative Data: Natural Sciences and Humanities & Social Sciences (1925-1968).

H = Humanities & Social Sciences

N = Natural Sciences.



64 Analysis of Variance

The Analysis of Variance technique was used to examine whether the likely trend in the pattern of incidence of the different cataloguing elements could be predicted on the basis of the data collected and trend recognised for the period 1940 to 1968. The hypothesis $Ho_i = \beta_i = 0$, for i = 1, 2, 3 ... was tested for some of the curves given in the preceding sections. Since the sample used in the study is small in relation to the total number of books published, the Analysis of Variance could be helpfully applied only to the cases where the regression line showed a fairly good angle of slope. This is found in three curves for books in the Natural Sciences. These curves are:

1 Single Personal Authorship;
2 Collaborator; and
3 Series.

The ANOVA tables for the curves for these three elements are presented in the succeeding sections. The expected value of F is taken from Formulae and tables for statistical work by C R Rao, S K Mitra, and A Matthai (1966).

641 ANOVA for Single Personal Authorship in the Natural Sciences (Fig 1)

Source	df	SS	MSS	F	
				Calc	Exp (5%)
Regression	1	236.3	236.3	33.3	7.7
Error	4	28.2	7.0		
Total	5	264.5			

Since F_{calc} is greater than F_{exp} the null hypothesis is rejected, that is $\beta \neq 0$. The trend of incidence of Single Personal Authorship in the Natural Sciences is, therefore, significant and predictable on the basis of the data collected.

642 ANOVA for Collaborator in the Natural Sciences (Fig 2)

Source	df	SS	MSS	F	
				Calc	Exp(5%)
Regression	1	771.7	711.7	8.6	7.7
Error	4	329.9	82.5		
Total	5	1,041.6			

Since F_{calc} is greater than F_{exp}, the null hypothesis is rejected, that is $\beta \neq 0$. The trend of incidence of Collaborators in the Natural Sciences is, therefore, significant and predictable on the basis of the data collected.

643 ANOVA for Series in the Natural Sciences (Fig 4)

Source	df	SS	MSS	F	
				Calc	Exp (5%)
Regression	1	472.2	472.4	16.8	7.7
Error	4	112.8	28.2		
Total	5	585.2			

Since F_{calc} is greater than F_{exp}, the null hypothesis is rejected, that is, $\beta \neq 0$. The trend of incidence of Series in the Natural Sciences is, therefore, significant and predictable on the basis of the data collected.

7 FINDINGS

The following are some of the findings from the analysis of the data for the period 1940-68.

71 Single Personal Authorship

The incidence of Single Personal Authorship is decreasing with time both in the Natural Sciences as well as in the Humanities and the Social Sciences.

72 Two-Joint Personal Authorship

The incidence of Two-Joint Personal Authorship is increasing with time in the Natural Sciences. In the Humanities and in the Social Sciences, it is very slightly decreasing with time.

73 Corporate Authorship

The incidence of Corporate Authorship is increasing with time both in the Natural Sciences as well as in the Humanities and the Social Sciences. The rate of increase is comparatively slight in the latter subject-fields.

74 Collaborator

The incidence of collaborators is increasing with time both in the Natural Sciences as well as in the Humanities and the Social Sciences. The rate of increase of collaborators in the Natural Sciences is quite significant particularly from mid-1950s.

75 Series

The incidence of Series is increasing with time both in the Natural Sciences as well as in the Humanities and the Social Sciences. The rate of increase is comparatively more steep in the Natural Sciences.

8 CONCLUSION

81 Revision of Standard

It can be inferred from the results of the analysis of the data presented in the preceding sections that at present, out of the total number of books catalogued by a cataloguer in a given period -- say, one year -- there will be comparatively a larger proportion of books presenting complexities, such as Two-Joint Authors, Collaborators, Corporate Authors, and Series than would have been the case in the past. Therefore, other factors remaining the same, a cataloguer will be able to complete only a fewer number of books per year today than might have been possible in the past, say, even a decade ago. This leads to three points for consideration:

1 There will be need to modify the standard for the number of books to be catalogued by a person in a year, set up a few years ago;

2 To maintain the same performance standard as in the earlier years in terms of the number of books catalogued in a year, the methods of cataloguing may have to be modified so as to increase the productivity of the cataloguer or additional hands will have to be employed; and

3 Since there is a predictable trend in the higher incidence of the books presenting complexities

for cataloguing, the two points for consideration mentioned above will have to be taken up periodically.

82 Further Studies Necessary

Studies such as the one presented in this paper can be made in different areas of library work and in different kinds of libraries so as to facilitate:

1 Determination of the periodicity of review of changes and trends in the different areas of work; and

2 Revision and adaptation of existing standards of work, wherever necessary.

91 ACKNOWLEDGMENT

We are grateful to Shri B S S Gupta, DRTC, for guidance in the statistical analysis of data.

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ANALYSIS OF SUBJECTS: A CASE STUDY.

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A knowledge of the structure and development of the universe of subjects is necessary for the design and development of schemes for classification. For this purpose, an analysis of the subjects embodied in documents, with the aid of the postulates and principles formulated by Ranganathan, are helpful. As a case study, this paper presents data and comments on the result of facet analysis of an assortment of compound subjects going with the (BS) Medicine. The intension of a large number of subjects embodied in books published in recent years is greater than those published during a generation or two earlier.

Abbreviations Used:

(AI) = Anteriorising Isolate
(BS) = Basic Subject
[E] = Energy Facet
[MM] = Matter-Material Facet
[MP] = Matter-Property Facet
[P] = Personality Facet
[S] = Space Facet
[T] = Time Facet

0 INTRODUCTION

A scheme for library classification is essentially a scheme for classification of subjects. Therefore, the designer and the reviser of a scheme for classification should have a thorough knowledge of the "structure" and "development" of the universe of subjects.

01 Attributes of Universe of Subjects

The various attributes of the universe of subjects, with which a classificationist may be concerned, are:

1 The attributes relating to the structure of the subjects, such as

11 Kinds of phases and their pattern of combinations in the formation of complex subjects,

12 Kinds of facets and their pattern of combination in the formation of compound subjects, and

13 Kinds of isolate ideas and the order of arrays forming the focus in each facet of a subject; and

2 Attributes relating to the development of the universe of subjects, such as

21 The rate of incidence of new seminal ideas in each subject, and

22 Modes of development of new subjects.

02 Need for Reliable Data

The classificationist should be able to get reliable data on these attributes of the universe of subjects, in order that the scheme for classification can be fitted to

1 Give a coextensive and expressive representation of the subjects embodied in documents; and

2 Keep pace with the developments in the universe of subjects.

For this purpose, the classificationist should conduct different kinds of surveys and make use of the findings, as far as possible, in the design and development of the schemes for classification.

03 Scope of the Paper

This paper presents a case study in gathering information on one of the attributes of the universe of subjects. In particular, it attempts to study the

1 Growth in the number of facets incident in a set of compound subjects going with the (BS) Medicine;

2 Pattern of combination of different kinds of facets in the set of compound subjects going with the (BS) Medicine;

3 Incidence of sub-facets in the Basic Facet of the compound subjects going with the (BS) Medicine;

4 Incidence of sub-facets in the isolate ideas forming facets of the compound subjects going with the (BS) Medicine; and

5 Incidence of different kinds of phases in the complex subjects with Medicine in at least one of the phases.

1 PROCEDURE

As a first step, all the entries for books listed under the subject heading "Medicine" in the *English catalogue* (1925) and in the *British national bibliography* (= BNB) (1951 and 1967) were selected for study. Documents which would go with such subjects as Fire Protection, Protection from Explosive, etc, were not selected.

11 Table 1. Total Number of Books Selected

Source	Total Number of Books		%
	Selected	Listed (Approx)	
English catalogue (1925)	25	13,000	0.2
BNB (1951) ..	325	16,000	2.0
BNB (1967) ..	530	27,000	2.0

It can be seen from the above table that between 1925 and 1951, there is an increase in the percentage of books on subjects going with the (BS) Medicine. The percentage, however, remains same between 1951 and 1967. Of these, there is no book having complex subject in 1925; there are 25 in 1951, and 30 in 1967 (See Sec 6).

12 Method of Analysis of Subject

The first five steps of the standard procedure of the nine steps for classification of a document laid down by S R Ranganathan (2) were applied.

The title of each book was made expressive by filling up the ellipsis, as far as possible. In the case of the books listed in the English catalogue, the detection of the ellipsis was difficult, because of the alphabetical arrangement of the entries of the books without any Feature Headings. But in the case of the BNB, the specific Feature Headings of each entry was helpful in filling up the ellipsis.

2 FACET ANALYSIS

The data collected were grouped according to the number of facets forming components of the compound subjects. In the counting of facets, the (BS) and the (AI) were each taken as a facet. Table 2 in Sec 21 gives data on the incidence of facets in the compound subjects going with the (BS) Medicine for the years 1925, 1951, and 1967.

21 Table 2. Number of Facets

N of Facets	1925		1951		1967	
	N of books	% of 25	N of books	% of 300	N of books	% of 500
1	4	16	10	3.3	10	2.0
2	9	36	71	23.7	65	13.0
3	4	16	93	31.0	170	34.0
4	7	28	95	31.7	171	34.2
5	1	4	31	10.3	75	15.0
6	-	-	-	-	9	1.8

22 Trend in the Incidence of Facets

1 The mode of incidence of facets is between 3 and 4 in 1951 and 1967; it is 2 in 1925.

2 There is a decrease with time in the percentage of subjects having 1 and 2 facets, and an increase of those with 3 or more facets. This indicates that books published in recent years embody subjects of greater intension than in the earlier years.

3 COMBINATION OF FACETS

31 Two-Faceted Subjects

Table 3 in Sec 311 gives data on the different kinds of combination of facets in two-faceted subjects.

311 Table 3. Two-Faceted Subjects

SN	Kind of Combination	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	(BS)"(AI)	5	20.0	16	5.3	10	2.0
2	(BS). [S1]	--	-	3	1.0	5	1.0
3	(BS); [1MP1]	1	4.0	41	13.7	40	8.0
4	(BS), [1P1]	3	12.0	11	3.7	10	2.0
	Total	9	36.0	71	23.7	65	13.0

312 Annotation

Among two-faceted subjects,

1 The combination (BS)"[AI] has the maximum percentage of books in 1925. But it decreases in the later years. This indicates that the production of reference books on Medicine as a whole in UK, is declining.

2 The combination (BS).[S1] has the same percentage of books in 1951 and 1967. Thus, there is no change in the trend in the production of books giving descriptive account of Medicine in UK.

3 The combination (BS):[1MP1] has the maximum percentage of books embodying two-faceted subjects, in 1951 and 1967. Among these, the books on "Disease in general" are dominant. It is maximum in 1951.

4 The percentage of books with the combination (BS),[1P1] had decreased during the later years. There is thus a fall in the production of books on "Organ *qua* Organ" in Medicine.

32 Three-Faceted Subjects

Table 4 in Sec 321 gives data on the different kinds of combination of facets in three-faceted subjects.

321 Table 4. Three-Faceted Subjects

SN	Kind of Combination	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	(BS)"(AI)"(AI)	1	4	1	0.3	-	-
2	(BS)"(AI).[S1]	-	-	2	0.7	2	0.4
3	(BS).[S1] " (AI)	1	4	-	-	1	0.2
4	(BS).[S1] ' [T1]	-	-	-	-	1	0.2
5	(BS) ; [1MP1] " (AI)	1	4	6	2.0	14	2.8
6	(BS) ; [1MP1] . [S1]	-	-	3	1.0	3	0.6
7	(BS) ; [1MP1] : [1E]	1	4	38	12.7	57	11.4
8	(BS) ; [1MP1] ; [1MP2]	-	-	-	-	1	0.2
9	(BS) , [1P1] " (AI)	-	-	-	-	1	0.2
10	(BS) , [1P1] . [S1]	-	-	-	-	1	0.2
11	(BS) , [1P1] : [1E]	-	-	1	0.3	1	0.2
12	(BS) , [1P1] ; [1MP1]	-	-	42	14.0	84	16.8
13	(BS) , [1P1] ; [1MM1]	-	-	-	-	1	0.2
14	(BS) , [1P1] , [1P2]	-	-	-	-	3	0.6
	Total	4	16	93	31.0	170	34.0

322 Annotation

Among the three-faceted subjects

1 The combination (BS),[1P1];[1MP1] has the maximum number of books during 1951 and 1967, and none at all in 1925. Most of the subjects with this combination are of the kind "Disease of human organ", and a smaller number on "Anatomy" or "Physiology" of human organs.

2 The combination (BS);[1MP1];[E] has about 12 per cent of the total number of three-faceted subjects, during each of the years 1951 and 1967.

There was only one book with this combination in 1925. Most of the subjects with this combination are of the kind "Therapeutics of Disease", and a small number on either "Etiology" or "Diagnosis", or "Pathology" of disease.

3 The combination (BS);[1MP1]"(AI) shows an increase in percentage in 1967. This implies the production of a large number of reference books, such as Encyclopaedia and Dictionary on subjects of greater intension.

4 The combination (BS)"(AI)"(AI) has one book each in 1925 and in 1951. It is a "Biographical Serial".

5 The combination (BS)"(AI).[S1] has two books each in 1951 and in 1967. This combination represents, in this case study, "History of Medicine in Great Britain".

6 The combination (BS).[S1]"(AI) representing "Medical Statistics in Great Britain" has one book each in 1925 and 1967.

7 The subject represented by the combination (BS),[1P1];[1MM1] was "Strontium-90 in the bone of the human body". Here, Strontium-90 is deemed as a manifestation of [MM].

33 Four-Faceted Subjects

Table 5 in Sec 331 gives data on the different kinds of combinations of facets in four-faceted subjects.

331 Table 5. Four-Faceted Subjects

SN	Kind of Combination	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	(BS).[S1]'[T]" (AI)	-	-	4	1.3	3	0.6
2	(BS);[1MP1].[S1]"(AI)	-	-	-	-	3	0.6
3	(BS);[1MP1].[S1]'[T]	-	-	3	1.0	2	0.4
4	(BS);[1MP1]:[1E]"(AI)	1	4	6	2.0	15	3.0
5	(BS);[1MP1]:[1E]'[T]	-	-	1	0.3	1	0.2
6	(BS); [1MP1]:[1E].[S1]	-	-	1	0.3	2	0.4
7	(BS); [1MP1]: [1E], [2P1]	2	8	29	9.7	32	6.4
8	(BS), [1P1] ; [1MP1]. [S1]	-	-	-	-	5	1.0
9	(BS), [1P1] ; [1MP1] " (AI)	-	-	2	0.7	15	3.0
10	(BS), [1P1] ; [1MP1] : [1E]	3	12	45	15.0	84	16.8
11	(BS), [1P1] ; [1MP1]; [1MP2]	1	4	2	0.7	5	1.0
12	(BS), [1P1] ; [1MM1] . [S1]	-	-	-	-	1	0.2
13	(BS), [1P1] , [1P2] ; [1MP1]	-	-	2	0.7	3	0.6
	Total	7	28	95	31.7	171	34.2

332 Annotation

Among the four-faceted subjects

1 There seems to be an increasing incidence of reference books during 1967. It is 7.2 per cent as against 4 per cent in 1925 and 1951. This may be an indication of the trend in production of more reference books on subjects of greater intension;

2 The combination (BS);[1MP1];[1E],[2P1] has the lowest percentage of books in 1967 of the three years under consideration. Most of the subjects in this combination of facets are of the kind "Methods of treatment of diseases in general".

3 The Host Subject (BS),[1P1];[1MP1] has the maximum percentage of books in all the three years. It is 12 per cent in 1925, 15 per cent in 1951, and 22 per cent in 1967. The majority among these subjects is on "Treatment of Disease of Organ". This is represented by the combination (BS),[1P1];[1MP1]:[1E]. The combination (BS),[1P1];[1MP1]"(AI) occurring in 1951 and 1967 represents reference books largely on "Disease of an organ of a human body". This combination (BS),[1P1];[1MP1];[1MP2] represents subjects such as "Genetics of the neurological disorders in human body".

4 The combination (BS),[1P1],[1P2];[1MP1] has books only in 1951 and 1967. This represents subjects such as "Metabolism of cerebrospinal fluid".

34 Five-Faceted Subjects

Table 6 in Sec 341 gives data on the different kinds of combination of facets in five-faceted subjects.

341 Table 6. Five-Faceted Subjects

SN	Kind of Combination	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	(BS).[S1],[1P1],[1P2]" (AI)	1	4	-	-	-	-
2	(BS);[1MP1]:[1E].[S1]'[T1]	-	-	-	-	1	0.2
3	(BS);[1MP1]: [1E];[2MP1]"(AI)	-	-	1	0.3	-	-
4	(BS);[1MP1]: [1E], [2P1]"(AI)	-	-	3	1.0	8	1.6
5	(BS);[1MP1]:[1E];[2P1].[S1]	-	-	-	-	1	0.2
6	(BS),[1P1];[1MP1].[S1]"(AI)	-	-	-	-	2	0.4
7	(BS),[1P1];[1MP1].[S1]'[T1]	-	-	1	0.3	1	0.2
8	(BS),[1P1];[1MP1]:[1E]"(AI)	-	-	4	1.3	16	3.2
9	(BS),[1P1];[1MP1]:[1E]; [2MP1]	-	-	1	0.3	2	0.4
10	(BS),[1P1]:[1MP1]:[1E].[S1]	-	-	1	0.3	-	-
11	(BS),[1P1];[1MP1]: [1E],[2P1]	-	-	18	6.0	38	7.6
12	(BS),[1P1]; [1MM1]; [1MP1]; [1MP2]	-	-	-	-	1	0.2
13	(BS),[1P1],[1P2];[1MP1]"(AI)	-	-	-	-	1	0.2
14	(BS),[1P1],[1P2];[1MP1]:[1E]	-	-	2	0.7	4	0.8
	Total	1	4	31	10.2	75	15.0

342 Annotation

1 The combination (BS),[1P1]; [1MP1]: [1E], [2P1] has the maximum number of books among the five-faceted subjects. In 1951, it had 6 per cent and in 1967 nearly 8 per cent. This combination usually represents subjects dealing with a particular method of treatment of diseases of an organ.

2 The combination (BS),[1P1];[1MP1]:[1E]" (AI) shows an increase from 1.3 per cent to 3.2 per cent from 1951 to 1967. This shows an upward trend in the production of reference books on "Treatment of disease of a particular organ".

3 Similarly, the combination (BS); [1MP1] ; [1E], [2P1] " (AI) also shows an upward trend in the production of reference books on subjects such as "Particular method of treatment of disease" in 1967.

35 Six-Faceted Subjects

Table 7 in Sec 351 gives data on the different kinds of combination of facets in six-faceted subjects.

351 Table 7. Six-Faceted Subjects

SN	Kind of Combination	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	(BS), [1P1] ; [1MP1] : [1E].[S1]"(AI)	-	-	-	-	1	0.2
2	(BS),[1P1];[1MP1]:[1E],[2P1]"(AI)	-	-	-	-	5	1.0
3	(BS),[1P1],[1P2];[1MP1]:[1E]"(AI)	-	-	-	-	2	0.4
4	(BS),[1P1],[1P2];[1MP1]:[1E],[2P1]	-	-	-	-	1	0.2
	Total	-	-	-	-	9	1.8

352 Annotation

Books having six-faceted subjects appear only in 1967. Almost all of these are reference books on subjects such as "Treatment of diseases of different organs of the human body".

The combination (BS),[1P1],[1P2];[1MP1]:[1E],[2P1] represents subjects whose intension is the greatest among all the subjects analysed in this case study. The subject is "Use of ultrasonics to investigate soft tissue thickness on the human chest".

4 INCIDENCE OF DIFFERENT KINDS OF ISOLATE IDEAS

Table 8 in Sec 41 gives data on the incidence of different kinds of isolate ideas in the subjects analysed.

41 Table 8. Incidence of Different Kinds of Isolate Ideas

SN	Kind of Isolate	1925		1951		1967	
		Total	% of 25	Total	% of 300	Total	% of 500
1	(AI)	10	40.0	45	15.0	99	19.8
2	(T)	-	-	9	3.0	9	1.8
3	(S)	2	8.0	18	6.0	35	7.0
4	(E)	7	28.0	151	50.3	271	55.0
5	(MP)	11	44.0	255	85.0	459	91.8
6	(MM)	-	-	-	-	3	0.6
7	(P)	10	40.0	166	53.3	389	77.8

42 Annotation

1 It is evident from Table 8 that (MP) isolates have the maximum percentage of incidence in different compound subjects going with the (BS) Medicine in each of the three years under study. Further, its percentage of incidence is also on the increase with time. A majority of (MP) isolate ideas studied relates to different kinds of "Disease".

2 The (P) isolates also have a good percentage of incidence in compound subjects going with Medicine and it is also increasing with time. A majority of the (P) isolates refer to the different organs of the human body. However, there are a few (2P) isolates also -- it is 2 in 1925 and 50 in 1951 and

87 in 1967. These refer to different methods of treatment of disease, such as X-Ray Treatment.

3 The percentage of incidence of (E) isolates is also increasing with time. These isolates largely represent the idea of "Treatment".

4 The percentage of incidence of (MM), (S), and (T) isolates is low in all the three years under study. This indicates that most of the compound subjects going with the (BS) Medicine are not Space and Time oriented.

5 The percentage of incidence of (AI) is on the decrease in later years. In the earlier sections, we observed that there is an upward trend in the production of reference books in subjects of great intension. The decrease in the percentage of incidence of (AI) as a whole may be due to the fact that the incidence of non-reference books is greater in later years than that in 1925. Thus, although we have a lower percentage of incidence of reference books in later years, we have a great number of books as compared to that in 1925.

5 ANALYSIS OF SUB-FACETS

The sub-sections of this section will be devoted to the analysis of sub-facets of the facets forming compound subjects going with the (BS) Medicine. In this study, the Space Facet, Time Facet, and the Anteriorising Isolate Facet are excluded as they are generally facets common to many compound subjects going with different (BS). The (E) isolates are also excluded as they do not have more than one sub-facet. By 'Sub-facet' is meant any component of a

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3 The percentage of incidence of (E) isolates is also increasing with time. These isolates largely represent the idea of "Treatment".

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Basic Subject or of an Isolate forming a facet of a compound subject. For example, in the Basic Facet Child Medicine, "Medicine" is one sub-facet, and "Child" is another. Similarly, in "Infectious Diseases", "Disease" is one sub-facet and "Infection" is another, and so on.

51 Sub-Facets in the Basic Facet

Table 9 in Sec 511 gives data on the number of books and their percentage to the total number of books for Basic Facets having only one sub-facet and for those having two sub-facets.

511 Table 9. Sub-Facets in the Basic Facet

SN	N of Sub-facets	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	1	19	76.0	231	77	408	81.6
2	2	6	24.0	69	23	92	19.4

512 Annotation

There is a slight decrease in the percentage of books having two sub-facets in the Basic Facet. These are all Specials Basic Subjects.

52 Sub-Facets in [1P1]

Table 10 in Sec 521 gives data on the number of books and its percentage to the total number of books, for the different number of facets in [1P1].

521 Table 10. Sub-Facets in [1P1]

SN	N of Sub-Facets	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	1	4	16.0	27	9.0	28	5.6
2	2	4	16.0	90	30.0	220	44.0
3	3	-	-	15	5.0	40	8.0

522 Annotation

In recent years, there is a significant increase in the number of [1P1] isolates having two and three sub-facets. This may be taken as indication of subjects with greater intension appearing in book-form.

53 Sub-Facets in [1P2]

Table 11 in Sec 531 gives data on the number of books and its percentage to the total number of books for the different number of sub-facets incident in [1P2]

531 Table 11. Sub-Facets in [1P2]

SN	N of Sub-Facets	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	1	-	-	1	0.3	5	1.0
2	2	-	-	3	1.0	9	1.8

532 Annotation

There is an increase in the incidence of two-sub-faceted [1P2] isolates in 1967. This also shows a higher incidence of subjects of greater intension appearing in book form.

54 Sub-Facets in [1MM1]

[1MM1] isolates occur only in 1967. There are only 3 books having subjects with [MM] isolates. Of these, two [MM] have each two-sub-facets, and the other has only one sub-facet.

55 Sub-Facets in [MP]

Table 12 in Sec 551 gives data on the number of books and its percentage to the total number of books, for the different number of sub-facets in [MP].

551 Table 12. Sub-Facets in [MP]

SN	N of Sub-Facets	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	1	7	28	141	47.0	291	58.2
2	2	4	16	86	28.6	102	20.4
3	3	-	-	28	9.3	66	13.2

552 Annotation

There is an increase in the percentage of incidence of subjects having (MP) isolates with only one sub-facet and those having three sub-facets. But in the case of two sub-facets, there is a decrease in 1967. These distributions indicate that there is a trend towards a deeper study in Property Facet (largely of Diseases of the Human Body) of the Compound Subjects going with the (BS) Medicine.

56 Sub-Facets in [2P1]

Table 13 in Sec 561 gives data on the number of books and its percentage to the total number of books, for different number of sub-facets in [2P1].

561 Table 13. Sub-Facets in [2P1]

SN	N of Sub-Facets	1925		1951		1967	
		N of books	% of 25	N of books	% of 300	N of books	% of 500
1	1	2	8	22	7.3	34	6.8
2	2	-	-	28	9.3	53	10.6

562 Annotation

There is an increasing intensification in the study of Treatment Facet in Medicine, for most of the isolates forming [2P1] represent different methods of Treatment.

57 Observation

Because of the small number of books analysed, the analysis of sub-facets does not give clear indications of trend. Analysis of a large number of documents may give useful results.

6 ANALYSIS OF COMPLEX SUBJECTS

Table 14 in Sec 61 gives data on the number of books having Complex Subjects involving different kinds of phase relation. The percentages are of the total number of books selected each year. (See Table 1 in Sec 11)

61 Table 14. Kinds of Phases

SN	Kind of Phase Relation	1925		1951		1967	
		N of books	% of 25	N of books	% of 325	N of books	% of 530
1	General	-	-	6	1.8	7	1.3
2	Bias	-	-	17	5.2	15	2.8
3	Comparison	-	-	-	-	-	-
4	Difference	-	-	-	-	-	-
5	Tool	-	-	-	-	2	0.4
6	Influencing	-	-	2	0.6	6	1.1
	Total	-	-	25	7.6	30	5.6

62 Annotation

Fifty-five books out of the total of 880 selected for this case study, have complex subjects involving Phase Relation. These form a relatively small percentage. Among these, Bias Phase Relation has the highest incidence in 1951 as well as in 1967; followed by General Phase Relation and Influencing Phase Relation. Tool Phase has only two books and that too only in 1967.

7 CONCLUSION

71 General Trend

The analysis of facets, sub-facets, and phases of different subjects going with the (BS) Medicine, shows that

1 The books of recent years embody subjects of

greater intension than those of a generation or two earlier; and

2 There is a tendency towards the production of reference books on subjects of greater intension, in recent years.

72 Implication to the Classificationist

The implication of these facts to the classificationist is that he should

1 Provide for and develop guiding principles helpful in determining the position of the newly emerging Basic Subjects and Isolate Ideas in the place appropriate to them, without violation to the overall filiatory sequence of subjects; and

2 Develop a versatile notational system that has built-in capacity to accommodate new Basic Subjects and Isolates as and when they occur, in their respective schedules.

73 A Suggestion

The methodology suggested and the analysis made in this paper are largely for the purpose of demonstration. The results obtained should be taken as tentative. However, if this kind of survey is made with a large number of documents, taking compound subjects going with each Main Subject as given in the schedule of Main Subjects in the forthcoming Ed 7 of Colon classification (1), a more reliable picture of the structural and developmental aspects of the Universe of Subjects could be obtained. Such finding would be of value in formulating guiding principles for work in the idea plane and in developing and utilising a versatile notational system in the design of a scheme for library classification.

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EXPRESSIVENESS OF SUBJECT IN TITLES OF ARTICLES: A CASE STUDY.

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The Title of an article is one of the first points of contact of the reader and of the documentalist, with the subject of the article. Elements in the Title are used in recalling and identifying an article. The Title is the starting point in classifying a document by the Postulational Method. Certain kinds of KWIC indexes are essentially based on Titles of documents. A Title that expresses coextensively the specific subject of an article will be of help to the reader in selecting articles for perusal; it will also be of help in documentation in various ways. Data on the extent of expressiveness of titles of an assortment of 300 articles appearing in medical periodicals are presented. Only about 3 per cent of the titles are fully expressive. About 22 per cent of the titles are less than 50 per cent expressive. The ellipses in the title, are of various kinds -- omission of Basic Subject Term, Personality Isolate Term, Matter Isolate Term, and of Energy Isolate Term. Use of Derived Composite Terms, Synonymous Terms, and Eponymous Terms, is also a common feature. A cooperative approach on the part of Author, Editor, and Documentalist in formulating guiding principles for the construction of helpful titles of articles is necessary.

1 TITLE OF A DOCUMENT

11 Definition

The term 'Title' has been defined as the name of a work, such as a book, an article in a periodical, a technical report, a patent, and a standard (5).

12 Kinds of Title

Titles have been distinguished as Main Title, Sub-Title, Alternative title, Short title, Half title, Running title, and Binder's title, depending upon the function and the position of the title in the document. On the basis of the extent of expressiveness of the subject content of the document, titles may also be grouped as Tell-tale or Expressive title, Fanciful title, and Elliptic title (5,9).

13 Use of Title

1 Being the name of a work, some elements in the title, if not the whole of it in some cases, are remembered and used by readers in recalling the document;

2 Usually the title is expected to give a broad idea of the subject of the document concerned;

3 The first contact of the reader and of the documentalist with the subject of a document is often by way of its title;

4 In classifying a document we begin with the raw title of the document and through a series of steps arrive at the title expressing the specific subject of a document; and

5 The preparation of certain kinds of documentation lists may be totally dependent on the title of documents.

14 Need for Expressive Title

An Expressive Title is one that coextensively represents the subject of a document. The helpfulness of Expressive Titles in conserving the intellectual potential of readers and of documentalists has been pointed out (3). With the development of certain kinds of KWIC (Key Word-In-Context) indexes based on the title of documents the need for titles coextensively expressive of the subject of documents has been realised in an increasing measure (2). In the preparation of documentation lists based on contents pages of periodicals as was practised by the *Insdoc list*, the helpfulness of Expressive Titles is evident. The Indian Standards Institution has been seized of the problem in connection with the recommendations for the contents page of a periodical and the prelims of an article (1, 10).

15 Scope of the Paper

This paper presents data on the extent of co-extensiveness of titles of an assortment of articles. The different kinds of ellipses that occurred in the titles studied are also mentioned.

2 PROCEDURE

21 Articles

An assortment of 300 articles published in different medical periodicals during 1967 and 1968 were used in the study. A bibliographical entry was made for each article on a standard cataloguing slip.

22 Analysis

Each document was perused and its subject was facet analysed according to the Method of Postulates ((8). Separate entries were made for each of the subjects in a multifocal document. The Title in Standard Terms (Step 5) was compared with the Raw Title -- that is, the title of the document. For each document, the Kernel Terms not found in the Raw Title were counted and recorded. Each of such

Kernel Terms was also separately noted on a catalogue slip for further study.

Example:

Raw Title:	Treatment of tuberculosis.
Title in Standard Terms at Step 5 of the Method of Postulates:	Child Medicine (BS). Lung [1P1]. Tuberculosis-Acute [1MP1]. Treatment [1E]. Streptocillin [2P1].
Number of Kernel Terms in the Raw Title	2
Number of Kernel Terms in the Title in Standard Terms	6
Therefore, the percentage of expressiveness of the Raw Title is:	33.3

3 DATA ON PERCENTAGE OF EXPRESSIVENESS

The following table presents data on the percentage of expressiveness of the raw titles and the number of raw titles having a given percentage of expressiveness.

SN	Expressiveness of Raw Title in %	N of Titles	Cumulative total	% of total $\frac{c \times 100}{300}$	Cumulative %
a	b	c	d	e	f
1	10-19	3	3	1.0	1.0
2	20-29	15	18	5.0	6.0

SN	Expressiveness of Raw Title in %	N of Titles	Cumulative total	% of total $\frac{c \times 100}{300}$	Cumulative %
a	b	c	d	e	f
3	30-39	18	36	6.0	12.0
4	40-49	31	67	10.3	22.3
5	50-59	66	133	22.0	44.3
6	60-69	55	188	18.3	62.6
7	70-79	45	233	15.0	77.6
8	80-89	57	290	19.0	96.6
9	90-99	0	290	0.0	96.6
10	100	10	300	3.3	99.9

41 Annotation

1 Only about 3 percent of the titles were fully expressive.

2 About 22 percent of the titles were less than 50 percent expressive.

5 ELLIPSIS IN TITLE

51 Kinds of Ellipsis

From the data given above it is seen that nearly 97 percent of the titles contained some ellipsis or other and therefore, were not coextensive with the subject of the document. The titles with ellipsis were further examined. The following table presents data on the kinds of ellipsis.

SN	Ellipsis	% of Titles (out of 300)
1	Basic subject term	78
2	Personality isolate term	22
3	Matter isolate term	36
4	Energy isolate term and [2P] term	47

52 Examples

521 Basic Subject Term

1 GEORGE (R B) and others.- Roentgenographic appearance of viral and mycoplasm pneumonias. (Amer rev resp dis. 96;1967;1144-50).

2 STEWART (T G) and others.- Role of radiotherapy in the management of malignant tumours of the salivary glands. (Amer j roentgenol. 102;1968;100-8).

In each of the above examples the Basic Subject Term 'Medicine' is not mentioned.

In a title of a document dealing with a Complex Subject presenting a Phase Relation, the Basic Subject Term may not be mentioned in both of the two phases. In the title "X-ray spectrum for orthopaedic surgery", the missing Basic Subject terms are 'Radiation physics' and 'Medicine'.

The high incidence of ellipsis of Basic Subject term may be explained by the fact that its mention in the title of an article may not serve any useful purpose from the point of view of the specialist reader. It would be considered redundant as the other Kernel Ideas in the title usually indicate the main subject to which the article belongs. Further, among the articles published in a periodical devoted to a particular subject-field, there is a fair amount of homogeneity that the need for resolution of homonym among subjects of the articles by the use of Basic Subjects arises rarely. Thus, the omission of the Basic Subject term from the title of articles is a common feature in most of the subjects.

522 Personality Isolate Term

For subjects going with the Main Subject "Medicine", the "Organs" of the human body constitute the schedule of Personality Isolates, in Round 1, Level 1.

In the title,

> Mucous gland hypertrophy in babies and children aged 15 years or less. (Brit j dis chest. 62;1968;11-8),

the organ affected is the "bronchus". It is not explicitly mentioned in the title. The cases of omission of explicit mention of the Organ Isolate -- that is, Personality Isolate -- were of the kinds mentioned in the following table:

SN	Kind of Omission	Example of Title	Personality Idea not represented in Title
1	True omission	Treatment of tuberculosis	Lung
2	Organ Isolate implied in Disease Isolate	Treatment of phthisis (Phthsis = Tuberculosis of lungs)	Lung
3	Use of generic name of organ system when a specific organ of the system is dealt with	Disorders of the uriniary system. (Disorders of urethra alone dealt with)	Urethra
4	Use of generic name of organ system alone when several, but not all, the organs of the system are dealt with	Physiology of ductless glands. (Deals with Spleen, Thyroid, Hypophysis)(It is a multifocal subject)	Spleen. Thyroid. Hypophysis.

523 Matter Isolate Term

Most of the isolates deemed to be manifestation of the Fundamental Category Matter, were Matter-Property Isolates. Almost all the Matter-Property isolates occurring in the subjects studied, represented one disease or other.

There were two broad categories of ellipsis of Matter-Property isolates. These were:

1 Host Matter-Property Isolate; and
2 Qualifier to the Host Isolate.

As in the case of Personality Isolates, the cases of omission of explicit mention of Matter-Property Isolate in the titles of articles were of the kinds mentioned in the following table:

SN	Kind of Omission	Example of Title	Matter-Property Isolate not represented in Title
1	Idea of disease implied by other terms in the Title	X-ray spectrum for orthopaedic surgery	Structural disease
2	Mention of one disease only when the article deals with other diseases also	Chronic bronchitis (Deals with Emphysema also)	Emphysema
3	Use of a single generic term when the article deals with several specific diseases	Diseases of the respiratory system. Chiari anamolies	(Name of the specific diseases)
4	Name of disease contained in a Derived Composite Term	Treatment of Phthisis (the derived composite term "Phthisis' denotes tuberculosis of lung)	Tuberculosis

The use of synonymous and eponymous terms to name a disease is a common feature in many titles in the medical field:

Examples of Synonym:

1. For "Food and mouth disease", synonyms used are "Epidemic stomatitis", and "Epizootic stomatitis".
2. For "Lymphogranulomatosis", synonym used is "Hodgkin's disease".
3. For "Lipoid granulomatosis", synonym used is "Schuller-Christian disease".

Examples of Eponym:

Addison's disease
Bazin's disease
Caisson disease
Cushing's disease
Hansen's disease
Hodgkin's disease
Little's disease
Schuller-Christian disease
Vaquez's disease
Weil's disease

53 Qualifier in Matter-Property Facet

The Qualifiers occurring in the Matter-Property Facet were mostly those qualifying the Host Isolate "Disease". The Qualifiers could be grouped as associated with or representing the following:

1. Causative agent
2. Epidemicity (Localisation)
3. Mode of transmission
4. State of disease
5. Duration of disease
6. Signs and symptoms

531 Causative agent

Qualifying Kernel Ideas denoting the causative agent are not mentioned in the title of some of the documents. Sometimes a generic name is used. Here are two examples:

SN	Term in the Title of article	Specific causative agent dealt with
1	Bacterial infection	Salmonella (infection)
2	Poisoning	Chloropromazine (poisoning)

532 Epidemicity

Qualifying Kernel Ideas, such as 'Endemic', 'Sporadic', and 'Pandemic' denoting the localisation of the disease are not explicitly mentioned in the title of some of the articles.

533 Mode of transmission

Qualifying Kernel Ideas, such as 'Infectious', 'Non-infectious', 'Water-borne', and 'air-borne' denoting the mode of transmission of the disease are not explicitly mentioned in the titles of some of the articles.

534 Stage of disease

Qualifying Kernel Ideas, such as 'Primary', 'Secondary', 'Tertiary', 'Symptomatic', and 'Asymptomatic' denoting the stage of the disease are not explicitly mentioned in the titles of some of the articles.

535 Duration of disease

Qualifying Kernel Ideas, such as "Week's duration" and "Month's duration" denoting the duration of the disease are not explicitly mentioned in the titles of some of the articles. Example: Title of Article: "Reiman's periodic disease", From the article, it was noted that the duration of the disease was six days.

536 Signs and Symptoms

Ideas denoting signs and symptoms of a disease helpful in its diagnosis are extensively discussed in many articles. Such Qualifying Kernel Ideas may include "blood pressure", "pulse rate", "State of appetite", "Vomitting", and various kinds of structural abnormalities such as displacement, dislocation, and tumour. These ideas are not explicitly mentioned in the titles of some of the articles.

537 Prognosis

Qualifying Kernel Ideas such as "chronic", "good", and "fatal" denoting prognostic characteristics of the disease are not explicitly mentioned in the titles of some of the articles. Example: Title of article: "Hodgkin's disease of the lung with cavitation". A perusal of the article showed that the prognosis had been indicated as "fatal".

54 Energy Isolate Term

Many articles dealt with the diagnosis, prevention or treatment (or a combination of these) of disease. The cases of omission of the explicit mention of the Energy Isolates in the titles of articles were of the kinds mentioned in the following table:

SN	Kind of Omission	Example of Title	Energy Isolate Idea not represented in Title
1	True omission	Temporal meningiocele (Deals with diagnosis and surgical treatment)	Diagnosis. Surgery.
2	Use of Derived Composite Term and/or Eponymous Term	Ascheim-Zardek test. Babinski's sign. Billroth operation.	

55 Isolate Term in [2P]

An isolate in [2P] may be of the following kinds:

1 The technique;
2 The aid;
3 The chemical / drug;
4 The apparatus;
5 The environmental conditions of pressure, temperature, etc; and
6 The time element,

involved in the diagnosis, or treatment, of the disease concerned. The title of an article may not explicitly mention the name of the technique etc. The cases of omission of the explicit mention of [2P] isolate term were of the following kinds:

SN	Kind of Omission	Example of Title	(2P) Isolate Idea not represented in Title
1	True omission	1 Temporal meaningiocele (Deals with diagnosis using Penumoencephalogram)	Pneumoencephalogram
		2 Diagnosis of urinary tract tuberculosis (Renography using radioactive sodium iodohippurate)	Renography Radio-active sodium iodohippurate
		3 Acute melioidosis in a soldier home from S Vietnam.	Treatment with Streptomycin
		4 Treatment of angina pectoris	Push-button pain-stopper
2	Use of a generic term when a specific technique etc is dealt with	Radiotherapy of cervial lymph node	Gamma ray from Cobalt-60
3	Use of Derived Composite Term and/or Eponymous term	Wasserman test. Widal test. Freyer's operation. Blalock's operation	

56 Other Kinds of Omission

The following are illustrative of other kinds of omission of explicit mention of ideas involved, in titles of articles:

1 Information whether the study was an experimental one;

2 The animal used and the conditions of the experiment in the case of an experimental study;

3 Space Isolate term;

4 Time Isolate term; and

5 Information whether it is an approach document such as a bibliography, recipe, tabulated data, etc.

6 GENERAL REMARKS

61 Title made for Specialist Reader

It would appear that, in general, the titles of articles are constructed with the specialist reader in view. The omission of the explicit mention of the Basic Subject term, the use of Derived Composite terms, and Eponyms, in the title supports this conjecture. The ellipsis arising out of this practice is not an inconvenience to the specialist reader. Further, the omissions and the use of short technical names for an idea that would involve several terms for a full expression, help to economise on the number of terms in a title. This is of some consideration with respect to the cost of publishing. However, the "True omissions" and the use of a generic term when a specific idea is dealt with, is not a helpful practice. It is unhelpful even for the subject specialist.

62 Title made to Help Documentation

An Expressive Title will save time in documentation -- such as in the selection of articles, classifying, indexing, and preparing abstracts. There is a symbiotic relation between the title and the abstract of a document (4, 6). The time so saved can be utilised in serving the reader in fulfilment of the Laws of Library Science (7). In the "information transfer chain", economy should be thought of at each of its links. Such an approach will alone lead to overall economy and efficiency in information transfer (11). At present, the inadequacy of the title in its use in documentation work is sought to be overcome by different methods at the stage of editing or publishing the article. These devices include:

1 Mention of key words suitable for indexing, at the beginning or in some other position in the text of the article;

2 Giving an abstract or author synopsis at the beginning of the article which may be used to prepare KWIC indexes, in classifying and for other documentation work;

3 Giving an annotation or otherwise amplifying the title in the contents page; and

4 Giving a Class Number to each article according to a scheme for classification.

The prelims of an article including the abstract, key word etc, are in many cases given separately in each issue of the periodical.

These practices confirm that the need is being felt in an increasing measure by editors and publishers of periodicals in providing help to the librarian in his documentation work.

7 AUTHOR-EDITOR-DOCUMENTALIST COOPERATION

1 Persons concerned with making editorial policies for periodicals should bear in mind the needs of the documentalist. Any editorial practice helpful to documentation will lead to better use of the articles.

2 The documentalist had developed techniques, such as facet analysis, and devices, such as Feature Heading for denoting expressively a subject in a way helpful to the majority of the specialist readers. These techniques and devices can be used with advantage in preparing the title and abstract of an article (3). A cooperative approach to the problem involving the three parties -- Author, Editor and Documentalist -- will be of mutual benefit to all concerned. Such cooperation will be particularly necessary in formulating guiding principles for constructing helpful titles.

8 ACKNOWLEDGMENT

I am grateful to Surg Capt M S Malhotra, Director, DIPAS, Delhi, for permitting me to contribute this paper to the DRTC Seminar (7)(1969).

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DRTC Seminar (7)(1969). Paper FA.

TECHNICAL PROCESSING: A CASE STUDY IN TIME AND MOTION.

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Data on time and motion study of the Accessioning, Classification, and Cataloguing work done in the Library of the Geological Survey of India, Calcutta, are presented. The time taken for the technical processing work could be reduced through a better deployment of the professional and semi-professional personnel on the different jobs involved.

1 SCOPE OF THE PAPER

This paper gives data on time and motion study of the Technical Processing work done in the Library of the Geological Survey of India, Calcutta.

2 FLOW CHARTING AS AN AID

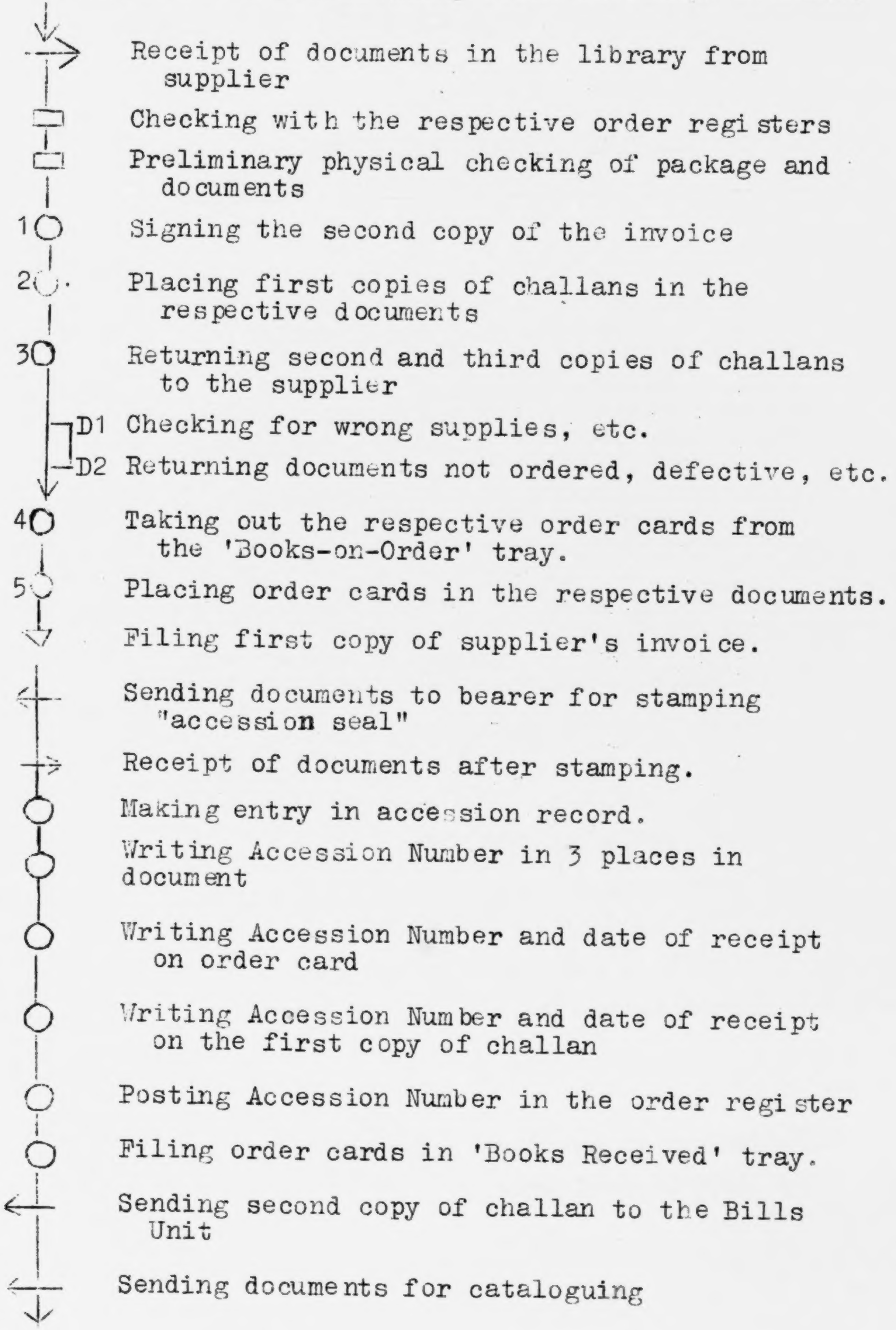
As a preliminary step to time and motion studies, it is necessary to standardise the sequence of work. This is helped by flow-charting the steps involved in the work under study.

21 Example

An example of the flow-charting is given below. The symbols used are:

→ Incoming
← Outgoing
▭ Checking
○ Action
▽ Store
D Deffered action
↓ Direction of flow

Flow-Chart for Accessioning Work: Purchased Document



Receipt of documents in the library from supplier

Checking with the respective order registers

Preliminary physical checking of package and documents

1 Signing the second copy of the invoice

2 Placing first copies of challans in the respective documents

3 Returning second and third copies of challans to the supplier

D1 Checking for wrong supplies, etc.

D2 Returning documents not ordered, defective, etc.

4 Taking out the respective order cards from the 'Books-on-Order' tray.

5 Placing order cards in the respective documents.

Filing first copy of supplier's invoice.

Sending documents to bearer for stamping "accession seal"

Receipt of documents after stamping.

Making entry in accession record.

Writing Accession Number in 3 places in document

Writing Accession Number and date of receipt on order card

Writing Accession Number and date of receipt on the first copy of challan

Posting Accession Number in the order register

Filing order cards in 'Books Received' tray.

Sending second copy of challan to the Bills Unit

Sending documents for cataloguing

3/5 TIME STUDY

3 PROCEDURE

1 The average time for doing a job was calculated on the basis of the time taken for doing the job on 10 units of each kind of document.

2 The observations were recorded following the random method and 'continuous watch-time study' suggested by Straith (2,3). The objective is to find out the time required to do a job on a "reasonable expectancy" standard.

3 Allowances were made for the following:

1 Complicated and misleading titles: 2.5 per cent, based on the experience of the personnel concerned;

2 Personal time allowance: 10 per cent time; and

3 Fringe benefit time: 10 per cent time.

These are the usual standards of allowances in work study.

4 It was found helpful to group some of the elements of a job in recording the time taken to do them.

4 ACCESSIONING WORK

41 Non-Serial Purchased Document

Item of Work	Details of Job	Average time of performance per unit (in minutes)
Receipt of document	1 Verification of document with book sellers' challan 2 Verification with order register 3 Signing the second copy of the suppliers' challan	1.5

Item of Work	Details of Job	Average time of performance per unit (in minutes)
	4 Filing the first copy of the challan	
	5 Returning second and third copies of challan	
Making document ready for accessioning	1 Thorough physical checking of documents	3
	2 Taking out respective order cards and placing them in documents	
	3 Stamping of 'accession seal' at three places in document	
Accessioning	1 Accessioning	4
	2 Writing Accession Number at three places in document	
	3 Writing Accession Number in first copy of challan	
	4 Writing Accession Number in order card	
	5 Writing Accession Number in order register	
Residual Work	1 Sending first copy of challan to Bills Unit	1.5
	2 Filing order card in "Books Received" tray	
	3 Sending documents to Cataloguing Unit	
	Total	10

42 Unpublished Reports, Reprints, Maps, etc

It was found that such a document took, on an average, 4 minutes less per unit as compared to time taken for the document mentioned in Sec 521. Out of the total number of documents acquired in the Library of the Geological Survey of India, the proportion of purchased documents to other kinds of documents is 50 : 50. Therefore, on an average, 6 minutes are required for accessioning a document.

5 CLASSIFICATION AND CATALOGUING

51 Non-Duplicate

Item of Work	Details of Job	Average time of performance per unit (in minutes
Making document ready for cataloguing	1 Verification of Accession Number 2 Checking of document with shelf list and catalogue 3 Sorting out duplicates	1.5
Cataloguing	1 Preparation of Main Entry Card 2 Preparation of Added Entry cards (3 on an average per document) 3 Preparation of shelf list card 4 Verification of catalogue cards	7
Classifying by UDC and Subject Index Entry	1 Determination of subjects of document 2 Verification of subject index cards in case of doubt	

Item of Work	Details of Job	Average time of performance per unit (in minutes
	3 Classifying 4 Preparation of Subject Index Entry 5 Assigning Author-mark 6 Writing Call Number in Main, Added, and shelf list cards	10
Residual work	1 Indicating number of copies of each card to be typed (3 on an average per document) 2 Sending documents for labelling 3 Sorting catalogue cards for typing 4 Filing shelf list card 5 Writing Call Number on book labels 6 Display of jackets 7 Writing Call Number in accession record 8 Sending documents to stack	2
Comparing and filing	1 Main Entry Card: 4 (One in alphabetical part and 3 in classified part) 2 Added Entry cards: 3 on an average	9.5
	Total	30.0

52 Duplicate Copy

It was found that a duplicate copy of a document took an an average 4 minutes per unit. The percentage of duplicate copies received in the library is about 16. Therefore, the average time for cataloguing a document works out to 26 minutes.

6 CONCLUSION

The following are some of the findings of the time and motion study:

61 About 32 minutes of professional and semi-professional time is required for the technical processing of the non-periodical publications received in the Central Library of the Geological Survey of India (Calcutta) from the time of the receipt of a document to the time of making it ready for the stackroom. In addition, about 8 minutes of the bearer's time is required.

62 The allocation of work to the professional and semi-professional staff is not fully satisfactory.

63 The time taken and the cost of technical processing of new acquisitions could be reduced when the backlog of work is completed and the work conditions are improved.

64 The flow of work from one person to another should preferably be continuous and not interrupted frequenently to do various unconnected jobs as it happens at present.

65 If time studies are made for the different items of work in different libraries, a suitable performance standard can be developed for each of the items of work for the different kinds of libraries (1).

66 Students of library science should be made aware of and helped to practise time study, work measurement, and evaluation techniques by adopting suitable teaching techniques in the library schools.

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DRTC Seminar (7)(1969). Paper FB.

RECLASSIFICATION.

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Data on the work of reclassification -- change-over from one scheme of classification to another -- undertaken in a technical library containing about 50,000 volumes are presented. The policy decisions in regard to classification, cataloguing, and shelving in order to secure consistency in work and details of the different steps in the reclassification work are briefly discussed. The different categories of personnel and the number in each category, the kind of work done by each category of personnel, the daily output per person, sample data on man-hours spent, and the costing of reclassification of a book, are dealt with. The average cost of reclassifying a book works out to Rs 1.25.

0 INTRODUCTION

01 Scope of the Paper

This paper describes and presents data on the work of reclassification of the book collection in a technical library.

02 Characteristics of the Collection

The total number of books in the collection in 1967, when reclassification work was taken up, was about 50,000. The majority of the books in the collection are on subjects in the field of Mathematical Sciences and of Physical Sciences. Most of the books are in fairly active use -- that is, the number of little-used books is practically negligible.

03 Need for Reclassification

The books were earlier classified according to Colon Classification (CC) Ed 3 (1950). This was found unhelpful and inadequate to give efficient service to readers. A change-over to Universal Decimal Classification (UDC) was decided upon.

04 Timing of Reclassification

In the second half of 1967, the library was shifted to a spacious new building. More shelving space became available. An expansion of the services of the library was planned. Additional staff was recruited. It was decided to take up the reclassification work towards the end of that year.

1 POLICY DECISION

In order to ensure systematic work and proper coordination of the steps involved, it was found helpful to make certain policy decisions. The decisions taken are mentioned in the succeeding sections.

11 Classification

1 All the books -- old books and new additions -- in the library are to be classified according to the latest edition of UDC.

2 New additions from 1 December 1967 are to be classified by UDC.

3 The first three letters in the Entry Element for the name of an author (or the Heading used as substitute for the author, wherever applicable), are to be used in forming the Book Number.

4 The books in the more used subjects are to

be reclassified first and the less used ones later.

Note.- This sequence more or less coincided with the sequence of Main Classes in CC. The books in the mathematical, physical, and biological sciences were taken up first in that sequence, and then the books in the Humanities.

12 Cataloguing

1 The unit card principle is to be followed in preparing the entries.

2 Subject Analytical Entries are to be prepared, wherever necessary, for the different component facets in the UDC Number.

3 The added entries are to be filed in the alphabetical part of the catalogue among the entries for the books awaiting reclassification.

4 The following Collection Symbols are to be used:

Collection	Symbol
Reference ..	R
Textbook, Reference	TR
Textbook ..	T
Oversize ..	(Overlining Book Number)
Special Collection	(Underlining and overlining Book Number

13 Shelving of Books

1 A book issued from the collection awaiting reclassification, on return, is to be shelved separately and taken up for reclassification

subsequently.

2 A reclassified book is to be shelved with the books on the same subject irrespective of whether it files among the reclassified books or those awaiting reclassification.

Annotation.-

1 This procedure was considered and subsequently found helpful to the readers in that they were able to locate the books on a given subject more or less within the range of a single bay instead of being directed to different sequences -- the old CC sequence and the new UDC sequence.

2 Example of Reshelving: In Metallurgy (F191) there were 40 books. By the time they were taken for reclassification, 10 more books were added. The old collection of 40 books were arranged on the first two top planks of the unit rack. The new additions were kept on the third plank. From the fourth plank onwards, the CC sequence was continued.

2 SYSTEM ANALYSIS

The work of reclassification consisted of nine main steps, the work in each of which was carried out in the sequence mentioned below:

0 Collecting books for reclassification;
1 Finding out relevant cards from the catalogue;
2 Reclassification;
3 Checking of classification;
4 Cataloguing;
5 Preparation of book;
6 Checking of prepared book;
7 Filing of cards; and
8 Shelving of books.

The work done in each of the above-mentioned steps is described in the succeeding sections.

20 Collecting Books for Reclassification

1 Each day in the evening, a set of about 50 books are collected from the shelves and kept on the classifier's table for reclassification.

2 The books returned by readers and requiring reclassification are also collected and brought to the reclassification section.

21 Finding Cards from Catalogue

1 For each book, the corresponding Shelf List card is picked out with the aid of the Call Number of the book.

2 The Main Entry of each book is picked out from the classified part of the catalogue with the aid of the Shelf List.

3 The Main Entry card is clipped to the corresponding Shelf List card and the pair arranged alphabetically by the Heading in the Main Entry.

4 The added entries for each book are picked out with the aid of the Tracing Section of the Main Entry.

41 If copies of one and the same book had been earlier catalogued separately, all the relevant entries are picked out for making a consolidated entry.

5 The added entries for each book are clipped together to the corresponding Main Entry and Shelf List card pair and the set kept in the book to which they relate.

22 Reclassification

1 The CC Call Number given on the back of the title page of the book is circled using a pencil.

2 The book is classified according to the UDC and the UDC Number is written provisionally just below the circled-off CC Call Number.

3 The CC Call Number on the corresponding Shelf List card is erased and the UDC Number written in pencil in its place.

23 Checking of Classification

1 The librarian verifies the UDC Number assigned to each book and suggests corrections, if necessary.

2 After a Call Number is approved, the Shelf List card is removed from the book and sent for filing.

24 Cataloguing

1 The catalogue cards picked out for a book are examined and instructions given if new cards are to be prepared.

2 If a majority of the cards in a set of entries for a book is damaged, a process slip is made out conforming to the current practice of the library, for typing out the catalogue cards.

3 The catalogue cards or the process slip, as the case may be, are kept in the book just after the title page, along with the appropriate Shelf List card.

4 The UDC Number is typed out on the right hand top corner of the catalogue cards.

5 When the Heading in a Main Entry is corrected

or changed, a similar change or correction in the Headings in the corresponding added entries is also done.

25 Preparation of Book

1 The old book label on the spine of the book is removed by wetting it.

2 The old date label is removed, if necessary.

3 A fresh book label is pasted on the spine of the book.

4 A fresh date label is pasted, if necessary.

5 The old Call Number on the catalogue cards, book cards, etc is erased.

6 The UDC Number is written in Indian ink on the book label and the date label.

Annotation.- If any book requires repair, it is sent to the bindery.

The work of preparing a book is to be completed before shelving it.

26 Checking of Prepared Book

1 Each book and the corresponding catalogue cards are checked to ensure that the corrections have been carried out properly.

2 The catalogue cards are taken out of the book and the book sent for shelving.

27 Filing of Cards

1 The catalogue cards are sorted into the following two groups:

1 To be filed in the classified part of catalogue; and

2 To be filed in the alphabetical part of the catalogue.

2 The cards to be filed in the alphabetical part are interfiled with the existing cards in the catalogue cabinet.

3 The cards to go into the classified part are kept separately in the classified sequence.

4 The Shelf List cards are filed back in the Shelf List cabinet.

3 WORK-FLOW

A book is not usually kept beyond six days in the reclassification section.

31 Charting

The following Table indicates the pattern of work-flow in relation to the reclassification of a book.

Day	Work in	
	Forenoon	Afternoon
1	Finding out catalogue cards for books collected from shelves the previous evening (See Sec 21(3) to (6))	Collecting books from shelves, and picking out related shelf list cards (See Sec 21(1) (2))
2	Reclassification (See Sec 22)	Checking of classification (See Sec 23)
3	Typing of Call Number on Catalogue Card. Preparation of fresh cards, if necessary (See Sec 24)	
4	Preparation of book (See Sec 25)	
5	Checking of prepared books with cards (See Sec 26)	Filing of catalogue cards (See Sec 27)

32 Shelving of Books

The reclassified books are shelved, as a routine, by the staff in charge of stackroom maintenance. Shelf labels and guide cards are prepared as needed.

33 Class Index Entries

Class Index Entries are prepared after checking the Main Entries in the classified part of the catalogue.

Annotation.- The preparation of Class Index Entries was taken up as a separate job. The data relating to this work are not included in the present study. In a copy of the UDC schedules, the term which has been used in the Class Index Entries was marked off. This marked copy of the schedule was used as a control.

4 PERSONNEL FOR RECLASSIFICATION

41 Categories of Personnel

The following categories of personnel were employed in the reclassification work.

1 Professional staff;
2 Skilled staff; and
3 Unskilled staff.

42 Professional Staff

The professional staff consisted of persons with a university degree or a diploma in Library Science and some experience in library work. Technical work, such as classification and cataloguing, was done by the professional staff. They also trained the other categories of staff in the different kinds of work involved. In the initial stages, the professional staff also did the following kinds of work:

1 Taking out Shelf List cards (See Sec 21(1));
2 Checking catalogue entries; and
3 Filing entries in the catalogue.

Such work was later taken over by the other categories of personnel. For instance, the collection of books for reclassification was taken over by the unskilled staff; and the checking of the catalogue entries and filing them, by the skilled staff.

43 Skilled Staff

The skilled staff consisted of the clerical staff of the library who were given on-the-work-training. In addition to the typist on the regular staff of the library, an additional typist was employed on daily-wage basis and included in the reclassification team. Such personnel were trained to type out catalogue entries on the basis of process slips, to check the typed entries, and to file the cards in the catalogue.

44 Unskilled Staff

This category consisted of library attendants of Grades 1 and 2. One or two additional attendants were employed from time to time on daily wage basis. Such personnel were given training to do certain types of work mentioned in the chart in Sec 5. One attendant with a good handwriting could also write the Call Number on the spine of books, etc. This work was earlier done by the skilled staff.

45 Strength of Staff

The reclassification work was done by a team constituted as follows:

SN	Category of Staff	Number during the period	
		February 1968	Apr-June 1969
1	Professional	2	2
2	Skilled	2	3
3	Unskilled	3	5
	Total	7	10

5 WORK ASSIGNMENT

The following table gives information about the kind of work assigned to the different categories of personnel of the reclassification team.

SN	Kind of work (Reference to the section in the text)	Category of Personnel
1	Collecting books from the shelves and books returned by readers for reclassification (Sec 21(1)).	Unskilled
2	Picking out Shelf List cards for the books selected for reclassification (Sec 21(2)).	Unskilled
3	Picking out catalogue cards for the books selected for reclassification (Sec 21 (3) to (6)).	Unskilled
4	Reclassification and checking (Sec 22 and 23).	Professional
5	Typing of Call Number on catalogue cards, etc (Sec 24)	Skilled
6	Typing of fresh catalogue cards, if necessary, and checking them (Sec 24).	Skilled
7	Preparation of book after reclassification (Sec 25).	Unskilled
8	Checking of the prepared book (Sec 26)	Skilled
9	Filing of Shelf List cards and catalogue cards.	Skilled

SN	Kind of work (Reference to the section in the text)	Category of Personnel
10	Shelving of books	Library's regular stack room maintenance staff helped by the unskilled staff of the reclassification team, whenever possible

6 WORK MEASUREMENT

The average output of the reclassification team as a whole was 100 volumes per day. The following table gives data on the average daily output per person of the team, taking a day as six hours of work.

SN	Work	Average N of books completed per day by one person	Remarks
1	Finding out cards from the catalogue (See Sec 21(3) to (6)).	50	The person doing the work has to remain standing most of the time.
2	Reclassification, and recataloguing, if necessary, and checking (See Sec 22 and 23)	50	Max: 80; Min: 20. Complexity of subject and of cataloguing factors affect the output.

SN	Work	Average N of books completed per day by one person	Remarks
3	Typing of Call Number on catalogue cards, and fresh catalogue cards, if necessary (See Sec 24)	60	Several of the existing catalogue cards had to be corrected. At least one fresh card had to be typed out for each book
4	Preparation of book (See Sec 25)	40	... ...
5	Checking of the books prepared (See Sec 26)	150	... ...
6	Filing of cards (See Sec 27)	100	Average N of cards filed per day was 300. The output is effected by the total N of cards ready for filing, and whether the catalogue cabinets could be used without disturbing the readers using it, etc (See also Sec 24)

Note.-

Items 5 and 6 were adjusted in such a way that accumulation of pending work was avoided. In addition, there was some adjustment with the person who files the cards for the new additions.

7 MAN-HOURS SPENT

71 Samples from Two Periods

As has been mentioned in Sec 11, the reclassification work was started on 1 December 1967. In

February 1968, a total of 900 volumes were reclassified. This may be called Period A. Again, during the summer vacation in 1968 (April, May, June), an additional 5,500 volumes were reclassified. This period may be called Period B. Data on work done in these two periods are given in Sec 72 as samples.

72 Data

The following table gives data on the total manhours spent on each item of work in the two periods A and B.

Note.- A = Period A, 900 volumes reclassified
B = Period B, 5,500 volumes reclassified

Work	Number of Man-hours					
	Professional		Skilled		Unskilled	
	A	B	A	B	A	B
Finding catalogue cards	--	-	--	-	90	600
Reclassification	150	618	-	-	-	-
Typing	--	-	85	630	-	-
Preparation of book	-	-	-	-	155	900
Checking	35	-	--	225	-	-
Filing cards	--	-	55	330	-	-
Total ..	185	618	140	1,185	245	1,500
Average N of vol handled per man-hour	4.9	8.9	6.4	4.6	3.7	3.7
% increase or decrease in the N of vol handled per manhour between Periods A and B	+80		-33		0	

73 Annotation

1 In both the periods, the work of picking out cards from the catalogue was done by attendants. In period A, the average number of volumes per day for which cards were picked out was 60, while for period B, it was only 50. This was due to the fact that in period B, the Shelf List cards were also picked out and the sets of cards relating to each volume kept in the related volumes by the attendant himself. In period A, this work was done by the professional staff.

2 In period A, the average number of books reclassified per day by professionals was 36. The output increased to 50 volumes per day in period B. This was due to the fact that picking out the Shelf List card and also keeping the set of cards relating to each book in the book were done by the attendants, relieving the professional staff of such work.

3 The number of volumes handled per manhour by the professional staff increased by 80 per cent in period B.

4 The number of volumes handled per manhour by the skilled staff decreased by 33 per cent in period B.

5 The overall productivity of the unskilled staff in terms of the number of volumes handled per manhour did not change between the two periods.

8 COST ANALYSIS

81 Salary of Personnel

The monthly salary of a person in the different categories of personnel employed in the reclassification work may be taken as follows:

1 Professional .. Rs 400.00;
2 Skilled .. 250.00; and
3 Unskilled .. 200.00.

82 Estimation of Cost of Reclassification of a Book

Each person put in at least six hours of work a day. The average number of working days in a month may be taken as 25. The following table gives data on the cost of man-hours for the different categories of personnel.

Period	Number of Books	Professional		Skilled		Unskilled		Total	Per Vol
		Man hour	Rs	Man-hour	Rs	Man-hour	Rs	Rs	Rs
A	900	185	492	140	232	245	325	1,049	1.16
B	5,500	618	1,643	1,165	1,992	1,500	1,995	5,640	1.00

Taking into account the leave salary of the staff, the cost of posting the new Call Numbers in the Accession Register, and the cost of stationery, the cost of reclassification per volume was about Rs 1.25.

DRTC Seminar (7)(1969). Paper CA.

PREPARATION OF A DOCUMENTATION LIST: JOB ANALYSIS AND COSTING.

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In 1963 the research work at the Central Food Technological Research Institute, Mysore, was reorganised into a number of precisely formulated projects. An efficient local documentation list became a necessity. The monthly Library bulletin of the Institute's Library listing articles under the broad classes of the Colon Classification was not adequate. A depth schedule for Food Technology was designed with guidance from DRTC and a separate minutely classified and adequately featured documentation list was started in July 1966. The different parts of the documentation list are mentioned and the structure of the entries in the classified part and in the alphabetical part is illustrated with examples. The items of work, the sequence in which they are done, and the time taken to do each item in the compilation and distribution of an issue of the documentation list are enumerated. The categories of personnel employed on the different items of work and the costing of an issue of the list are dealt with. There has been a 40 per cent reduction over the last three years in the time taken to prepare the documentation list. The reasons for this increased output are mentioned. Steps taken to promote the use of the documentation list in CFTRI, and the useful role the documentation list is playing in keeping the scientists in the Institute and in similar other institutions receiving the list are indicated. Some steps to increase the efficiency of the service further are mentioned.

1 PRECURSORS TO DOCUMENTATION LIST

11 Additions List

In 1961 the library of the Central Food Technological Research Institute (CFTRI), Mysore, started issuing a monthly recent additions list entitled Library bulletin. Each monthly issue consisted of two parts. Part 1 gave a list of the books received in the library during the preceding month. The entries in this part were arranged in the classified sequence according to Colon Classification numbers. Part 2 gave a list of the titles of other documents such as technical reports, annual reports, standards, patents, and reprints of articles, received in the library. Wherever necessary abstracts or annotations were added to the entries. Such abstracts are now included in the monthly Food science abstracts issued by the Institute.

12 Addition of Part 3

In 1964, Part 3 was added to the Library bulletin. This part gave a list of the titles of articles selected from the current issues of about 200 out of the 480 periodicals received in the library. Each entry gave full bibliographical details of the article. The entries were arranged in a broad classified sequence according to CC. The addition of Part 3 implemented, to some extent, the recommendation of the Conference of Information Scientists (Mysore) (1963), that the library of a CSIR Laboratory should issue a project-oriented local documentation list. By then the research work in CFTRI had also been reorganised into a number of precisely formulated projects. The pressure for establishing an efficient local documentation service was keenly felt.

13 Separate Documentation List

By 1965 it was realised that a separate minutely classified and adequately featured documentation list for Food Technology -- the dominant subject of interest of CFTRI -- will be of considerable help to the scientists. Therefore, early in 1966, as a first step, a depth version of CC for the classification of the subjects going with the Host Subject Food Technology was prepared with the help of DRTC (6, 7). The articles already collected earlier for the Bulletin were made use of in selecting isolates for the schedule. From July 1966 a separate documentation list entitled Documentation list for food technology is being issued. As a result, in Part 3 of the Library bulletin articles in Food Technology are not included. The classification schedule has been improved upon from time to time on the basis of the findings of its actual use in the classification of articles included in the documentation list.

14 Scope of the Paper

This paper presents some data about the different jobs involved in the preparation of the documentation list, the man-hours spent, and the cost thereof.

2 SOME PARTICULARS ABOUT THE DOCUMENTATION LIST

21 General

1	Subject covered:	Food Technology
2	Number of periodicals scanned to pick out articles:	167
3	Frequency of publication:	Monthly

4 Approximate number of articles per issue: 150

5 Number of copies of each issue circulated: 200

6 Approximate number of users: 500

22 Parts of the Documentation List

Each issue of the documentation list consists of the following parts:

1 A Note to readers on how to use the documentation list in finding entries for documents on the subjects of their respective interests;

2 Alphabetical index to the subjects; and

3 Classified part consisting of Main Entries for the articles selected and arranged by Class Number.

23 Structure of an Entry

231 Main Entry

An entry in the classified part consists of the following items:

1 Class Number constructed according to the depth version of Colon Classification for Food Technology;

2 Feature Heading derived by Chain Procedure;

3 Serial Number of the entry;

4 Heading Section prepared according to the appropriate rules of the preferred cataloguing code;

5 Title of the document;

6 Host Section consisting of

61 Abbreviated title of the periodical;

62 Number of the volume;

63 Number of the issue, if necessary;

64 Year of publication;

65 Name of the month of the issue, if necessary; and

66 Pagination.

The preparation of the Main Entry generally conforms to the rules for the Main Entry in an abstracting periodical prescribed in the *Classified catalogue code* (5) and other standards prescribed for the purpose (3, 4).

Example:

F85,39ZW-0(9R8)-0FE;966;a01;a86-f811 Salad, Avocado, Freeze-drying, Lipid, Property, Variation, Autoxidation

895 N69 LIME (B J). Autoxidation of fatty acid lipid, and carotene of freeze dried avocado salad. (Food tech. 23;1967;171).

F85,39ZY-0(9S1)-0F4;g7 Apple sauce, Dehydration, Shelf life

896 N69 EISEN HARDT (N H) and others. Storage properties of dehydrated apple sauce etc. (Food tech. 23;1969;159).

F85,3C-0A1;961;b12;a860&gF85,3C:P1 Milk, Raw, Fat, Quality, Variability *influenced by* Churning.

897 N68 KROGER (M) and others. Churning in raw milk samples and its effect on the fat test. (J dairy sc. 51;1968;1776).

Note.- The term "Food Technology" is generally omitted from most of the Feature Headings as the documentation list covers articles in the field of Food Technology only.

232 Alphabetical Part

An entry in the alphabetical index consists of the Subject Heading derived according to the Chain

Procedure followed by the serial number of the corresponding entry in the Classified Part of the documentation list.

Example:

Apple sauce 896
Autoxidation, Variation, Property, Lipid, Freeze-drying, Avocado, Salad 895
Avocado, Salad 895
Churning *influencing* Variability, Quality, Fat, Raw Milk 897
Dehydration, Apple sauce 896
Fat, Raw, Milk 897
Freeze-drying, Avocado, Salad 895
Lipid, Freeze, drying, Avocado, Salad 895
Milk 897
Oxidation, Variation, Property, Lipid, Freeze-drying, Avocado, Salad 895
Property, Lipid, Freeze-drying, Avocado, Salad 895
Quality, Fat, Raw, Milk 897
Raw, Milk 897
Salad 895
Shelf life, Dehydration, Apple sauce 896

3 WORK MEASUREMENT

About 3,000 articles are scanned each month. About 150 articles are included in the *Documentation list for food technology* and about 250 articles in the *Library bulletin*. Table 1 gives details of the different kinds of jobs and the average time taken for each job in the preparation of the documentation list.

31 Table 1. Items of Work and Time Taken

SN	Item of Work	Time taken(min)	
		Per Unit	Total for 150 articles
1	Registration of periodicals (50 periodicals)		90
2	Typing out alphabetical list of periodicals registered		20
3	Scanning of contents page of periodicals to select articles	2	300
4	Tick-marking selected articles in the contents page		75
5	Tick marking the periodicals scanned in the alphabetical list of periodicals registered (See SN 2)		30
6	Typing out main entries on 75 x 125 mm slips	3	450
7	Picking out and arranging periodicals for perusal, etc from the periodicals section		50
8	Perusal of articles where necessary and depth classification of articles	10	1,500
9	Deriving Feature Headings by Chain Procedure	3	450
10	Arranging slips in the classified sequence		120
11	Entering Serial Number		30
12	Preparing slips for the Alphabetical Index of subjects by chain procedure (about 240 slips)	2	480
13	Arranging the Subject Headings in alphabetical sequence		75

SN	Item of Work	Average time(min)	
		per unit job	Total for 150 articles
14	Cutting stencils (average 20 stencils)	30	600
15	Proof correction of stencils		220
16	Taking out copies on duplicator (200 copies, each of about 20 pages)		90
17	Collation (200 copies)		190
18	Stapling (200 copies)		50
19	Preparation of addresses (outside) (70 copies)		140
20	Distribution to readers (Local and outside the Institute through post)		130
		Total Hours	83.00

32 Annotation

321 Spread of Work

The work of preparing an issue of documentation list usually extends over a period of three weeks, commencing from the middle of each month.

322 Immediate Display of Periodicals

After registration, the periodicals are displayed immediately in the periodical section for the use of readers. A list of the periodicals received is made available to the documentation officer (See Table 1, SN 2). The periodicals required for preparing the documentation list are collected in batches from the periodicals section. (See Table 1 SN 7).

323 Delay in Making Copies

Due to the centralisation of the duplication work there is some delay in the preparation of copies. Every effort is, however, made to distribute the copies of the documentation list before 15 of each month.

4 COST

Table 2 gives data on the different categories of personnel employed on the different items of work mentioned in Table 1, the man-hours spent and the cost of work.

41 Table 2. Category of personnel, man-hours and cost of work

SN	Category	Item of work (ref SN in Table 1)	Man-hour	Cost of work Rs
1	Upper Division Clerk	1,2	2.00	3.00
2	Scientist (Library)	3,4,5,8,9 10,12,15	53.00	238.00
3	Stenotypist	6,11,14	18.00	25.00
4	Junior Lab Asst	7,13,17	5.25	7.00
5	Duplicator Operator	16	1.5	2.00
6	Library bearer	18,19,20	5.5	5.00
		Cost of work		280.00
		Cost of stencil, paper, ink		80.00
		Total for 200 copies		360.00

5 INCREASE IN PRODUCTIVITY

In the course of the last three years it has been possible to reduce the time taken to do some of the items of work involved in the preparation of the documentation list. This is indicated in Table 3 in Sec 51. Some of the reasons for this saving of time are discussed in Sec 52 to 55.

51 Table 3. Comparative data on Man-hours

SN	Item of Work	Average man-hours	
		1966	1969 (*See* Table 1)
1	Selection of articles and depth classification	44	31.15
2	Chain indexing	16	9.15
3	Typing	30	18.00
4	Proof reading	16	6.50
5	Filing of slips	8	4.00
6	Duplicating	8	1.50
7	Collation, Stapling and Distribution	12	8.50
		134	78.20

Some of the factors that have helped in this reduction of time and therefore the cost of the preparation of the documentation list are mentioned below.

52 Classification

In the earlier stages, more time was taken for the classification of the articles using the depth schedule. However, after an experience of a few months, the classifier could reduce the time for classifying an article to an appreciable extent.

53 Class Index Entries and Feature Headings

In the earlier stages, a Class Index Entry had to be prepared for each and every sought link in the Class Number. As more and more documents were classified, it became possible to prepare in advance and keep ready certain frequently occurring Subject Headings for use in the preparation of Class Index entries and Feature Headings. This helped to reduce the time taken for preparing Feature Headings and Class Index Entries. Further, on the recommendation of specialists using the documentation list, the preparation of Class Index Entries for some of the links was avoided. In two earlier papers (1,8) some information on the production of Feature Headings in BNB is given.

54 Usual Abstract not Needed

As each article is minutely and coextensively classified, and as the Feature Headings are derived by Chain Procedure, there is practically no need for an elaborate, abstract of the usual kind (2). As the documentation staff became increasingly efficient in classifying and deriving Feature Heading the work of preparing abstracts could be practically eliminated and time saved thereby.

55 Other Items of Work

Similarly, several of the other items of the work is now done with greater speed than at the initial stages as the staff have gained experience and the knack of handling the different items of work and reduce wastage.

6 PROMOTION OF THE USE OF THE DOCUMENTATION LIST

The issue of the documentation list was started in July 1966. In the initial stages, in addition to giving a Note in the documentation list on how to use it to find articles on specific subjects, many readers were individually contacted by the library staff to inform and guide them in the use of the documentation list. Some readers had an inhibition for the long Class Numbers at the head of each entry. But when it was explained to them that the Class Numbers **give** a helpful arrangement of the entries bringing related subjects together and that the length of the number reflected the depth of the subject of the document, they were convinced. On the other hand we had also cases of readers requesting to be taught to 'decode' the number into the subject of the document!

7 USEFULNESS OF THE DOCUMENTATION LIST

71 Objective

The documentation list was started with the following objectives:

1 To keep the scientists of the CFTRI abreast of the current researches in the field of Food Technology;

2 To inform the scientists about the arrival and availability of various periodicals in the library;

3 To help the scientist in making retrospective search for documents on specific topics in the field of Food Technology;

4 To save the time of the scientist in document search and leave more time for his research work; and

5 To provide means for the fullest utilisation of the increasing number of documents published in the field of Food Technology

These objectives are being fulfilled by the documentation list in an increasing measure during the last three years.

72 Within CFTRI

The documentation list has been well received and used by the:

1 Project leaders and other scientists of the Institute. The project leader circulates the list among the members of the project team;

2 Students of the Institute. They have found it to be of particular use in preparing project reports. The helpful structuring of the subjects derived by the use of depth classification schedule appears to be of help to them in the preparation of the project reports; and

3 Library staff in doing reference service and in the preparation of retrospective bibliographies.

The main entries prepared for each documentation list is filed in the catalogue in the classified sequence as an aid to retrospective search for documents on specific subjects. It is proposed to keep these entries for about five years. During this period bibliographies on specified topics of interest to the Institute may be compiled and then the old entries may be discarded.

73 Outside CFTRI

Seventy copies of the documentation list are sent out on request to:

1 Scientists working in the field of food science and food technology;

2 Institutions where courses in food technology are conducted;

3 CFTRI Experiment Stations located in various parts of India; and

4 Food industries.

The keenness with which some of the Experiment Stations await the documentation list may be gauged from the fact that they send reminders to us if there occurs any delay in the issue of the documentation list.

At present the copies of the list are sent on a complimentary basis. However, there have been requests from institutions in India and abroad to send the list on a subscription basis.

There have also been requests for copies of the Depth Schedule for Food Technology.

8 REVIEW OF THE SITUATION

Early this year the publication of an international abstracting periodical entitled Food science and technology has been started by the International Food Information Service. The CFTRI is also issuing a monthly abstracting periodical -- the Food science abstracts. The need for the documentation list in this context was examined at the Institute recently. It has been found that it still plays a useful role:

1 As an 'appetiser';

2 Bridging the gap in the receipt of the international abstracts; and

3 Its subject-coverage being specifically

oriented to the needs of institute's research workers.

The issue of the documentation list on a weekly or fortnightly frequency is likely to increase its utility to the research workers. An integration of the preparation of the documentation list with the work of preparing the Food science abstracts issued by CFTRI is also being planned.

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5 Sec 231 RANGANATHAN (S R). Classified catalogue code. Ed 5. 1964. Chap TD.

6 Sec 13 SANGAMESWARAN (S V). Food technology: Depth version of CC. 1966. (Unpublished).

7 Sec 13 -- and GOPINATH (M V). Schedule of commodities in food technology. (Annual Seminar (DRTC). 5;1967; Paper J).

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DRTC Seminar (7)(1969). Paper GB.

PREPARATION OF "CURRENT LEATHER LITERATURE".

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Information on the subject, kinds of documents, number of periodicals, and languages covered by the monthly documentation list Current leather literature (CLL) and on the kind and number of abstracts prepared for and the parts of an issue of CLL, are given. The steps, and the quantum of professional, semi-professional, and non-professional work involved in the compilation and production of an issue of CLL are mentioned.

1 SCOPE OF THE PAPER

This paper describes and presents data on the work of compiling and producing the Current leather literature (CLL), an abstracting periodical published by the Central Leather Research Institute, Madras.

2 "CURRENT LEATHER LITERATURE"

21 Subjects Covered

CLL covers mainly the following subjects: Leather science, leather technology, and the manufacture of footwear and other leather goods. Documents in the following penumbral and related subjects are also covered to a lesser extent: Engineering, Chemistry, Chemical Technology, Textile Technology, Polymers and Plastics, Biology, and Agriculture.

22 Kinds of Documents Covered

CLL covers mainly the following kinds of documents:

1 Articles in periodicals received in the CLRI Library;

2 Patents, whose abstracts are given either in the primary periodicals or in the abstracting periodicals; and

3 Reports of conferences.

23 Number of Periodicals Covered

About 250 scientific and technical periodicals received in the CLRI library are scanned. Recently, on the basis of an inter-library cooperative arrangement, some periodicals received in the AC College of Technology and in the Indian Institute of Technology, Madras, are also scanned for CLL.

24 Languages Covered

A majority of the documents covered in CLL are in English. A few periodicals in other languages, such as German, French, Russian, Czech, and Bulgarian are also included.

25 Frequency of Publication

CLL is published monthly. A volume of it covers a period of one year -- from July of one year to June of the following year.

26 Abstract

261 Kinds of Abstract

The Author Synopsis given in the article is reproduced when

1 It is fully adequate; and

2 The language of the original is not known to any member of the abstracting panel.

Usually, an informative abstract is prepared for each article.

262 Number of Abstracts

Each issue of CLL contains, on an average, a hundred abstracts.

27 Clientele Served

The following categories of clientele receive CLL:

1 Research staff of CLRI;

2 Indian organisations connected with the leather industry;

3 International organisations connected with leather technology, the leather industry, and similar interests;

4 A few primary periodicals published abroad and received in exchange for CLL; and

5 A few abstracting services in the field of leather technology published abroad.

28 Structure of CLL

An issue of CLL consists of the following parts:

1 Serially numbered abstracts with Feature Headings. The abstracts are, in the first instance, usually grouped in the sequence of the following subject headings:

1 Leather science and technology;
2 Footwear and leather goods;
3 Textile technology;
4 Plastics and polymers;

5 Chemical technology;
6 Agricultural sciences;
7 Engineering;
8 Chemistry with all its branches; and
9 Biology with all its branches.

Within each of these groups, the abstracts are arranged according to UDC Number.

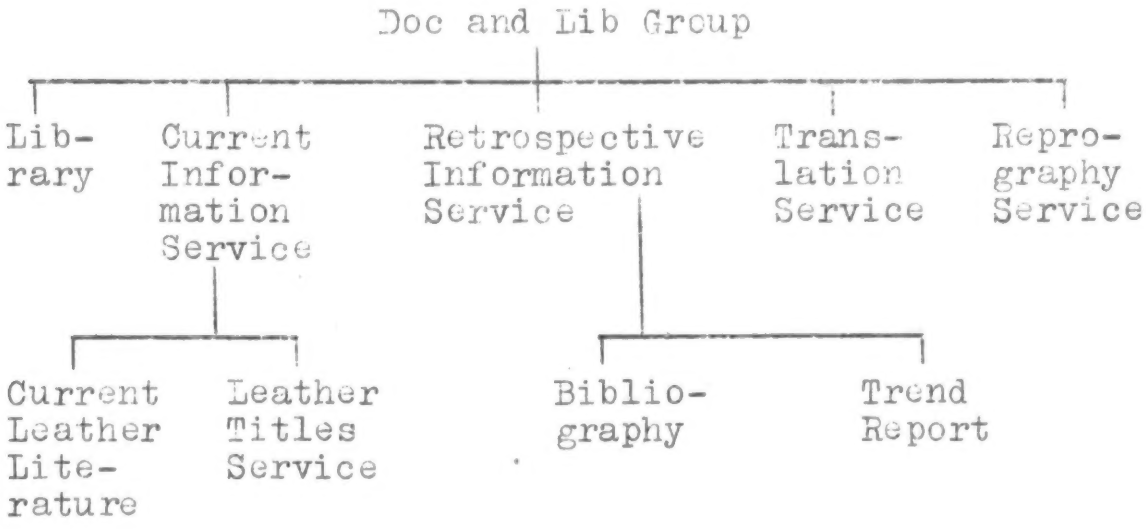
2 A list of the periodicals covered in the issue;
3 Index to the names of authors; and
4 Index to subjects.

The index number in (3) and (4) consists of the serial number of the abstract. These two indexes are cumulated annually.

3· PERSONNEL

The CLL is compiled, produced, and published by the Current Information Service Project (CIS) of the Documentation and Library Group in the Information Area of CLRI, as shown in Chart 1.

Chart 1. Documentation and Library Group in CLRI


Doc and Lib Group
Library
Current Information Service
Retrospective Information Service
Translation Service
Reprography Service
Current Leather Literature
Leather Titles Service
Bibliography
Trend Report

An Editorial Committee (EC) of subject specialists and a panel of abstractors composed of the members from the EC scan the periodicals and prepare abstracts.

4 ANALYSIS OF THE WORK OF PRODUCTION OF CLL

In the succeeding sections, the different items of work connected with the production of CLL are enumerated.

41 Scanning

1 Receipt of the periodicals by the CIS from the library.

2 Distribution of the periodicals to the members of EC according to their respective subject of specialisation, for scanning and selection of articles for abstracting and indicating the name of abstractor.

3 Return of the periodicals to CIS after scanning.

4 Sending the periodicals to the library for display for a week.

5 Receipt of the periodicals back in the CIS after a week.

42 Abstracting

6 Typing out on 8" x 5" card the Author Synopsis given in the original article wherever EC has indicated this procedure.

7 Making a Main Entry on 8" x 5" card for the articles for which abstracts are to be prepared by the Abstracting Panel (AP).

8 Sending the periodicals with the Main Entry cards to the appropriate members of the AP.

9 Preparation of abstracts by the AP.

10 Forwarding the abstracts with the periodicals to the appropriate member of the EC for technical editing.

43 Editing

11 Technical editing by the EC.

12 Receipt of the edited abstracts with the periodicals by the CIS from EC.

13 Final editing of the abstracts by the professional staff of CIS with reference to language, style of abstract, etc.

14 Return of the periodicals to the library.

44 Classification and Preparation of Indexes

15 Classification of the abstracts and providing Feature Heading.

16 Freezing the sequence of the entries.

17 Preparation of Author Index, Subject Index and the List of the Periodicals covered.

45 Production

18 Cutting stencils.

19 Checking the stencils.

20 Carrying out corrections in the stencils.

21 Taking copies.

22 Collating and binding copies.

23 Receipt of the bound copies in CIS.

46 Distribution

24 Distribution of copies within CLRI.

25 Preparation for despatch of copies outside the Institute -- preparation of the addressed covers, inserting the copy in them, and preparation of the mailing list.

26 Despatch of copies as per the mailing list.

27 Receipt in CIS of the certified copy of the mailing list.

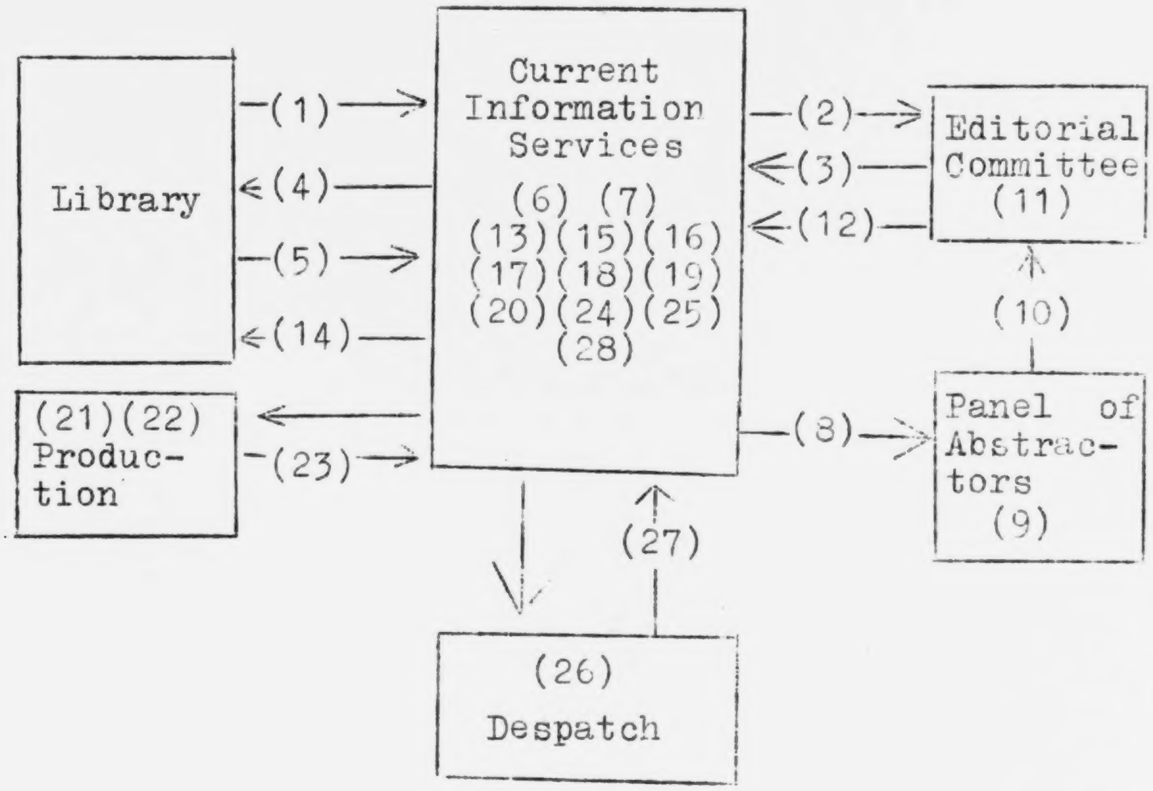
28 Keeping account of the copies produced.

47 Work-Flow

The following is a chart of the work-flow for CLL.

Chart 2. Work-Flow for CLL

Note.- The numbers in parentheses refer to the Serial Number of the operations in Sec 41 to 46.


Library
(1)
(4)
(5)
(14)
Current Information Services
(6) (7) (13)(15)(16) (17)(18)(19) (20)(24)(25) (28)
(2)
(3)
(12)
Editorial Committee (11)
(10)
(8)
Panel of Abstractors (9)
(21)(22) Production
(23)
(27)
(26) Despatch

5 ANALYSIS OF OPERATIONS

51 Cycle of Operations

The cycle of operations relating to the compilation and production of an issue of CLL takes one month. Operations such as receipt of periodicals from the library are continuous; others such as stencilling, are batch operations. For convenience, the continuous operations are considered on a weekly-periodicity basis and the a batch operations on a monthly-periodicity basis.

52 Kinds of Work

The following are the kinds of work involved in the preparation of CLL:

1 Professional -- requiring either knowledge of subjects or of documentation;

2 Semi-professional -- requiring such knowledge of library science as the preparation of author index, arrangement of entries, etc; and

3 Non-professional -- ability to do routine work, such as distribution of periodicals, and typing according to standards and instructions laid out for the purpose.

53 Items of Cost

The kind and number of persons utilised and their pay are as follows:

SN	Kinds of Personnel	Number	Salary
1	Non-professional (includes secretarial assistance)		
	11 Typist ..	1	Rs 199 + Allowance
	12 Attendant ..	1	Rs 80 + "
	13 Gestetner Operator	1	Rs 116 + "
	14 Binder ..	1	Rs 87 + "
2	Semi-Professional		
	21 Junior Technical Assistant	1	Rs 250 + "
3	Professional		
	31 Senior Documentalist	2	Rs 900 + " Rs 720 + "

A system of payment for abstracting at Rs 5/- per abstract for the abstracting work done outside office working hours, is being introduced. The man-hours spent on such abstracting work are not indicated in the job analysis table given in Sec 54.

54 Job Analysis for One Issue of CLL

SN as in Sec 41 to 46	Job Description		Man-hours per week	Total
Weekly: Non-Professional				
1	Receiving periodicals	..	4	16
2	Distribution to EC	..	2	8
3	Return of periodicals from EC to CIS	..	2	8
4	Display of periodicals in the library	..	1	4
5	Receiving periodicals back from library	..	1	4
6	1 Typing author-abstracts	..	6	24
	2 Checking	..	1	4
7	Typing main entries	..	4	16
8	1 Distribution to AP	..	4	16
	2 Follow-up work	..	2	8
12	Receiving back abstracts and periodicals	..	1	4
14	Separating out abstracts and return of periodicals to library		1	4
Weekly: Professional				
11	Technical editing	..	8	32
13	Final editing	..	4	16

'Current Leather Literature': Job Analysis GB54

SN as in Sec 41 to 46	Job Description	Man-hours per week	Total
Monthly: Non-Professional			
18	Stencil cutting ..		52
20	Stencil correction ..		8
21	Cyclostyling.		18
22	Binding ..		14
24	Internal distribution		2
25	Despatch ..		4
Monthly: Semi-Professional			
17	1 Preparation of Author Index		6
	2 Preparation of list of periodicals		3
19	Checking of stencil		
	First ..		20
	Second ..		6
20	Checking stencil corrections		6
Monthly: Professional			
15	1 Classification ..		40
	2 Feature Headings ..		4
16	Freezing ..		1
17	1 Preparation of Subject Index		6
	2 Checking ..		2
		Professional ..	101
		Semi-Professional	41
		Non-Professional	214
		Total	356

The ratio of the three categories of man-hours works out approximately as follows:

Professional: Semi-Professional:Non-Professional::

2.5 : 1 : 5.5

6 FUTURE PROGRAMME

It is proposed to extend the coverage of the CLL in terms of the number and kinds of publications. For this purpose, it would be helpful to know the requirements of readers in respect of the subjects to be covered, etc. A questionnaire is being sent to the users of the CLL to collect information on this and other aspects of the service.

7 ACKNOWLEDGMENT

The authors are grateful to the Scientist-in-Charge, CLRI, for his kind permission to contribute this paper to the DRTC Seminar (7)(1969).

. . .

DRTC Seminar (7)(1969). Paper GC.

INDIVIDUALISED DOCUMENTATION SERVICE FOR PACKAGING.

B L GUPTA, Librarian, Indian Institute of Packaging, 254-C, Dr Annie Besant Road, Bombay 25 (DD).

The characteristics of an individualised documentation service are mentioned. The omnibus documentation list Packaging abstracts (PA) issued by the Indian Institute of Packaging is not satisfactory in respect of pinpointed, individualised service to specialists in particular facets of the subjects in packaging manufacture and packaging industry. The subject coverage, language coverage, kinds of documents included, the layout, and structure of an entry in, PA are mentioned. A survey of the specific requirements of the specialist groups and industries receiving PA is recommended. Restriction of the coverage of PA to subjects of interest to specific groups of specialists, exhaustive coverage of documents in the respective specialised subject areas and issuing the documentation list in card form are proposed as first steps in improving the efficiency of documentation service to the specialists in packaging.

Abbreviations Used:

(BS) = Basic Subject
GDS = Generalised Documentation Service
IDS = Individualised Documentation Service
PA = Packaging abstracts, (Indian Institute of Packaging)

1 TERMINOLOGY

11 Documentation and the Laws of Library Science

Documentation may be defined as:

1 Promotion and Practice of bringing into use of nascent micro ideas by specialists (Law 1); and

2 Pin-pointed (Law 2);

3 Exhaustive (Law 3);

4 Expeditious (Law 4) service of nascent micro ideas to specialists;

5 In spite of the continuous ever-increasing cascade (Law 5) of nascent micro ideas constituting an ever-multiplying number of specialised subjects, communicated through several thousands of micro-documents such as articles in periodicals, technical reports, patents, standards and specifications (5).

12 Documentation Service

Documentation Service is the name given to Reference Service when the emphasis shifts from generalist reader to specialist reader. It is intensified reference service (6).

2 KINDS OF DOCUMENTATION SERVICE

Documentation Service may be of two kinds, namely,

1 Generalised Documentation Service (GDS); and

2 Individualised Documentation Service (IDS).

21 Generalised Documentation Service

GDS is a documentation service rendered

1 To a large group of specialists (Individuals or Corporate Bodies such as Government Departments, Industries, Institutions etc.);

2 Through a general documentation list containing abstracts on most of the facets of subjects in which the constituents of the group of specialists concerned are interested; and

3 Without any emphasis on any specific facet or requirements of any particular specialist group within the larger group. An example of this kind of service is IIP Packaging abstracts, supplied to the industries in India.

22 Individualised Documentation Service

IDS is documentation service rendered

1 To a specific group of specialists, whose interests are similar at an optimum level of specialisation; and

2 Through a documentation list containing abstracts only on those facets in which the constituents of the group specialise.

An example of this kind of service may be a documentation list on 'Paper Packaging' supplied to those who specialise in this field. The above kind of distinction has been made only for convenience and is tentative.

23 Summary of Characteristics of GDS and IDS

The following table gives a summary of the charac-characteristics of GDS and IDS derived from the definitions mentioned above.

Characteristic	Generalised Documentation Service (GDS)	Individualised Documentation Service (IDS)
1 Size of the group of specialists	Comparatively large group, the constituents of which can be further grouped on the basis of their specialisation at optimum level.	Comparatively small group of specialists whose interests are similar at an optimum level of specialisation.

Characteristic	Generalised Documentation Service (GDS)	Individualised Documentation Service (IDS)
	Example: Indian industries. A very large group each constituent of which is not interested in all the facets of Packaging, but only in some of them.	Example: A group consisting only of 1 Industry manufacturing paper for conversion; or 2 Paper converting industry; or 3 Paper packaging user industry.
2 Subject coverage	A subject of great extension or a group of subjects of small extension put together	A subject of lesser extension and greater intension

3 PRESENT METHOD OF SERVICE

30 Objective

The objective of the Documentation Service rendered by the Indian Institute of Packaging (IIP), is to

1 Keep the Indian industries and individuals concerned informed regarding the latest developments taking place in India and in foreign countries in the field of Packaging and allied subjects; and

2 Assist the staff of the Institute to minimise unintended duplication in research.

31 Packaging Abstracts

The IIP brings out a monthly documentation list entitled Packaging abstracts (PA) to help achieve the above-mentioned objectives.

32 Coverage

321 Subject

The subjects covered by the PA are those going with the (BS) Packaging and with a few other (BS) in the penumbral and allied regions of Packaging. The following have been recognised by us:

1 Commodity -- that is, the commodity to be packed, such as pharmaceutical, textile, and cosmetic;

2 Packaging Operation -- that is, the operations involved in packaging a commodity, such as filling, closing, and sealing;

3 Packaging Material -- that is, the material used for packaging a commodity. There are two kinds of materials:

31 Primary material, such as tinplate, polyethylene film, and corrugated board, and

32 Ancillary material, such as printing ink, adhesive, and steel strapping;

4 Container or Form of Material -- that is, the form in which the material is fabricated to be used as container. For example, bag (made of paper, polyethylene etc), bottle (made of glass, plastics etc), and can (made of tinplate, black plate etc);

5 Machinery -- that is, machinery and equipment used in any of the packaging operations, such as filling machine, labelling machine, and material handling equipment.

Current nascent documents on all these facets are covered in the PA. Abstracts on subjects falling in the penumbral region of Packaging are also included.

322 Kind of Documents

PA covers different kind of documents, such as articles in periodicals, standards, specifications, patents, reports, and monographs.

323 Language

Documents in the English language alone have been included so far. But the objective is to ensure that no nascent workable idea, irrespective of the language in which it has been expressed, is missed, and steps towards such a complete survey are being taken.

33 Layout

PA consists of two main parts, placed in the following sequence:

1 Alphabetical Subject Index; and
2 Abstracts.

Introduction, Contents Page, etc, are given wherever found necessary.

331 Alphabetical Subject Index Part

The Subject Index is prepared according to the Chain Procedure (3).

332 Abstracts Part

An entry in this part usually consists of five elements given in the sequence mentioned below:

1 Feature heading;
2 Name of author(s);
3 Specification of location or host document;
4 Abstract; and
5 Initials of the abstractor, if other than the documentalist.

Although the entries in the Abstracts Part are arranged in a classified sequence, they do not bear any Class Number. The entries have been arranged with the help of Feature Headings. A Depth Schedule for Classification of subjects going with the (BS) Packaging is just being developed. Therefore, the documents are not given any Class Number.

The Feature Headings are also derived according to the Chain Procedure (4). The Feature Headings, so derived, render the title insignificant. Therefore, the Title Section has been omitted from the Entry. This has been discussed in detail elsewhere (2).

34 Physical Form

PA is mimeographed on one side of the paper. On an average, each sheet contains 3 to 4 abstracts. Sufficient space is left between consecutive entries, to enable a user to cut the required entry, paste on to a standard catalogue card and arrange it in the desired sequence.

35 Periodicity

PA is issued in the first week of every month. It commenced publication in January 1968. The first four issues were brought out as per schedule. Later on, due to some unavoidable circumstances, it could not be brought out till August 1969. Its publication has been resumed from September 1969.

4 DEFICIENCY OF THE PRESENT SERVICE

41 High Percentage of Irrelevant Documents

At present, the PA is a general documentation list, covering various subjects going with the (BS)

Packaging and some other (BS). It is sent to various organisations, specialising in different subjects in Packaging manufacture and Packaging industry. As a result, an industry manufacturing sugar receives abstracts not only on the packaging of sugar, but also on the packaging of other commodities, such as furniture, heavy machinery, crockery, and cosmetics! It would also receive abstracts on materials and containers not used in packaging sugar. Thus, each industry receives a comparatively large number of abstracts on subjects in which it has practically no interest, and a small number of abstracts in subjects in which it has interest.

42 Case Study

As a case study, four groups of industries (See Sec 421) were selected to examine the approximate number of irrelevant abstracts each may receive on the basis of the present omnibus documentation list (1). The percentage of relevant abstracts worked out is approximate and tentative.

421 Table 1. Groups of Industries Considered

SN	Group	Subject of interest
1	1	Manufacture of metal containers, closures and accessories
2	2	Manufacture of paper and board, and containers and accessories
3	3	Manufacture of glass containers
4	4	Manufacture of food products

Table 2 in Sec 422 gives data on the analysis of the abstracts appearing in five issues of PA in relation to the subject interest of the industries.

422 Table 1. Percentage of Abstracts of Interest.

PA issue number	Total Number of abstracts	Number of abstracts of interests to Group			
		1	2	3	4
1	60	3	3	2	5
2	42	4	7	2	3
3	108	9	24	3	3
4	94	5	11	8	12
5	43	3	6	3	6
Total	343	24	51	18	29
% of abstracts of interest		7	14	5	8

423 Annotation

1 Out of the 343 abstracts published in the five issues of the PA only 7, 14, 5 and 8 per cent was of interest to the four groups of industries, respectively.

2 With the omnibus documentation list, the full potentiality of the helpful arrangement of the entries derived on the basis of a freely faceted depth classification could not be exploited to the advantage of each group of users.

43 Violation of Laws 2 and 3

After a look at PA issue 4, which contained only 94 abstracts, one of the specialists remarked "we need abstract of abstracts". What he meant was that it was not possible for him to go through so many abstracts to locate just those likely of interest to him.

44 Violation of Law 4

The cumulative search time spent by each specialist working on diferent facets of the subject in different industries, will be much more than the time spent by the documentalist in recognising the specific interests of the individual specialist and supply him with just the relevant abstracts. This will save considerable time at the output stage and thereby satisfy Law 4 of Library Science.

45 Curse of Law 5

As the number of abstracts increases, the number of items of 'no interest' will also cumulate. The search time to be spent by the specialists will also correspondingly increase. This may develop in him a tendency to overlook the complete publication and thereby overlook also some of the important abstracts. This will bring on the documentalist the curse of Law 5 of Library Science, which says "Documentation Service in spite of the continuous, ever-incr increasing cascade of nascent micro ideas".

5 FEATURES OF AN IDEAL DOCUMENTATION LIST

An ideal Documentation List should have the following essential features:

1 The documentalist should be continuously aware of the specific requirements of each specialist (Individual person or corporate body);

2 The documentation list should bring to the notice of each specialist only those documents in which he will be interested;

3 The items of interest brought out to the notice of the specialist should be presented in a readily usable form and enable the user to arrange the abstracts, if necessary, in the desired sequence;

4 The service should provide a guide to each specialist for the arrangement of the cards and finding of information in the manner most convenient to him;

5 There should be a continuous feedback from the specialist user to the documentalist information about the specific points of adequacy and inadequacy -- subject coverage, kinds of documents covered, classification, sequence of entries, method of presentation in an entry, abstracting, indexing etc -- of the documentation list issued to him; and

6 The documentation technique should be developed on the basis of this feedback.

6 METHOD PROPOSED FOR IMPLEMENTATION

61 Finding the Specific Interest

The first requisite for the proposed method will be to determine the interest of optimum level of specialisation of the individuals/corporate bodies for whom the documentation list is meant. This may help to limit the subject by appropriately narrowing down the extension. It could be done, in the first instance, with the help of questionnaire. This would be followed up by periodical visits to the factories and discussions with the specialists --

the users already receiving the service as well as the potential users.

62 World-wide Coverage

The documentation system would aim at an exhaustive coverage of all worthwhile documents on the various facets of the subjects going with the (BS) Packaging, irrespective of its form -- conventional and non-conventional -- language, space, etc.

63 Physical Form of Abstracts

A card form -- on standard size -- is suggested. The present method of cyclostyling on one side of each sheet implies that entries of interest to a particular specialist could be cut, pasted on to a standard size card, and arranged in a sequence desired by him. The proposed card form for the documentation list will facilitate this.

64 Guide to Maintain the System

The documentation service would also provide guidance to the specialist on the maintenance and use of his own personal documentation system.

7 PILOT PROJECT

The method proposed in Sec 6 above, may be experimented first with 'member industries'. It will provide data for evaluation and adaptation of the documentation service, wherever necessary, on the basis of the feedback from the consumers.

8 ACKNOWLEDGEMENT

I am indebted to Dr S R Ranganathan, National

Research Professor in Library Science, for his kind invitation to prepare this paper. I am also grateful to Major N V R Iyengar, Director, Institute of Packaging, for permission to contribute the paper to the DRTC Seminar (7)(1969).

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SHORT-RANGE REFERENCE QUESTIONS IN A SPECIALIST LIBRARY: A CASE STUDY.

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It is helpful to examine periodically the pattern of incidence of different kinds of reference questions put by different categories of readers. The need for such a survey is mentioned. Presents data on the short-range reference questions asked by different categories of readers in a library of an academic-cum-research type institution. The data are analysed in different ways and the particular patterns of incidence of different kinds of question commendted upon. The data on the subject-wise distribution of short-range questions is compared with the subject-wise distribution of the (1) library's holdings, (2) books and periodicals issued to readers and (3) staff, students, and research scholars of the institution constituting the potential users of the library. Subjects in the field of the Physical Sciences are seen to be the most dominant in each of these cases.

1 REFERENCE QUESTION

11 Two Kinds

Reference questions are usually grouped into two broad categories:

1 Short range (Ready-reference); and

2 Long range.

A question which does not take more than, say, 10 minutes to find the answer, is usually considered to be a short range question; and a question which requires prolonged search, or compilation of a bibliography, is usually considered a long-range question (2). The availability of good reference books, able reference staff, and efficient library tools, such as classification, cataloguing, and stackroom guiding, can help to convert a long-range reference question into a short-range one.

12 Short-Range Question

Short-range questions are of various kinds. Some requests of this type are:

1 Information on a specific subject that may be got from one or the other conventional reference books;

2 Help in using reference books to get information of the kind mentioned in category 1;

3 Help to locate in the library's collection some document or other with the aid of its Call Number or bibliographical specification; and

4 Information as to whether a document, with a particular bibliographical specification, is available in the library or not.

It will generally be the endeavour of the reference librarian to be able to devote more of his time on questions of the category 1, and to some extent, on questions of category 2. It would be necessary to make periodical checks by the reference staff whether this is actually the case in a library. For, there is a tendency on the part of

1 Many readers to request and, in some cases, demand, of the professional library staff help merely to locate and pick out from the shelves the documents; and

2 Library staff to oblige readers to a greater extent than is desirable and perhaps without discrimination and thereby unconsciously spend an

appreciable amount of time on trivialities.

This can particularly arise in a context where

1 Readers are not properly initiated into the use of the tools and techniques of the library, and into the disposition of the different collections;

2 The number of persons assigned reference service is inadequate; and

3 The reference staff are not adequately qualified and experienced.

2 SCOPE OF THE PAPER

This paper presents data on the number of different kinds of short range reference questions answered in a university type research institution. The data on the distribution of the questions by subjects are compared with those of the library's holdings of documents, the documents issued to readers, and the subject specialisation of readers.

The analysis of the data could provide information about the use made of documents and of the reference staff by different categories of readers, the time spent by the reference staff on different kinds of questions and on different categories of readers, whether the members of the reference staff are adequately utilised, and the need for improving existing tools and techniques and to develop new ones.

3 COLLECTION OF DATA

31 Items of Information

Data was collected on the following:

1 Readers served
  11 Different categories,

12 Number of readers in each category;

2 Short-range questions

21 Kinds of questions answered,

22 Number of questions in each kind;

3 Time spent in answering each kind of question;

4 Library collection

41 The main subject-fields represented in the collection of the library -- Books and Periodicals

42 Number of volumes in each main subject-field;

5 Circulation

51 The main subject-fields into which the books issued by the library fall,

52 The number of books issued in each main subject-field; and

6 Subject specilisation of the institution

61 The subject-fields of specialisation of the institute,

62 The number of teachers, postgraduate students, and research scholars in each field of specialisation.

32 Period Covered

The data was collected for a period of twelve months, from May 1967 to April 1968 inclusive.

33 Proforma

A proforma was designed and used in the collection of the data. Details of such a proforma have been given in another article (1).

34 Sample Studied

The total number of short range questions answered during the twelve month period was about

1,200. Out of this, the questions answered on fifty-days -- every eighth day in the twelve month period -- were selected and studied in greater detail.

35 Preliminary Sorting

351 Two Periods

The academic session of the institution begins on 1 August each year. It was conjectured that there may be a variation in the pattern of predominance of certain types of questions in the first three or four months immediately following the starting of the academic session as compared to that towards the close of the sessions. Therefore, the sample data was, in the first instance, sorted into two groups:

1 Data for the first four months (July to October 1967) -- Period 1; and

2 Data for the next four months (November 1967 to February 1968) -- Period 2.

This amounted to 773 questions on 36 days spread over a period of eight months,

352 Kind of Questions

It was found convenient to group the questions answered into the following categories:

1 Information about availability of document in the library given its bibliographical specification (Availability of document);

Example:

1. Do you have Parker and Haswells Zoology V2.

2 Do you have "Impressions of science in printing"

2 Locating document on the shelves given the Call Number or other bibliographical specifi-

cation (Locating document);

Example: Where is the book with the number D65e N63 located.

3 Information on specific subject, the search and finding of which does not take more than ten minutes (Specific subject query);

Example:

1 Address of the UP Agricultural Institute.

2 Details, preferably a photograph, of the Frequency Response Plotter.

3 Percentage of citric acid in lemon.

4 Guidance and help in the use of reference books for finding information (Guidance);

Example:

1 Where to find information on Copper Wire Making.

2 How to make a reading list on Silver Extraction.

5 Compilation of retrospective bibliographies.

In the detailed study, the last category of service is not included.

353 Category of Readers

The readers served could be categorised into the following three groups:

1 Postgraduate student;
2 Research scholar; and
3 Teaching staff.

A few "outside" scholars were also served (See Sec 561).

4 TABLES

41 Table 1. Average Time taken to Answer a Question

SN	Kinds of Question	N	Total time (in min)	Average time per question (in min)
1	Availability of document	61	334	5.5
2	Locating document	732	2,259	3.1
3	Specific subject query	20	161	8.0
4	Guidance	45	389	8.6

42 Table 2. Kind of Question and Category of Reader

SN	Category of Reader	Kind of Question							
		Availability of document		Locating document		Specific subject query		Guidance	
		N	%	N	%	N	%	N	%
1	Postgraduate Student								
	Period 1	10	33.3	251	59.5	6	33.3	7	46.7
	Period 2	3	20.0	164	64.0	5	83.3	5	50.0
2	Research Scholar								
	Period 1	15	50.0	119	28.2	5	27.8	3	20.0
	Period 2	6	40.0	65	25.0	-	-	2	20.0
3	Teaching Staff								
	Period 1	5	16.7	52	12.3	7	38.9	5	33.3
	Period 2	6	40.0	28	11.0	1	16.7	3	30.0
Total:									
	Period 1	30		422		18		15	
	Period 2	15		257		6		10	

43 Table 3. Percentage of Questions for each Category of Reader

SN	Category of Reader	Kind of Question									
		Availability of document		Locating document		Specific subject query		Guidance		Total	
		N	%	N	%	N	%	N	%	N	%
1	Postgraduate Student										
	Period 1	10	3.7	251	91.6	6	2.2	7	2.5	274	52.1
	Period 2	3	1.7	164	92.7	5	2.8	5	2.8	177	61.5
2	Research Scholar										
	Period 1	15	10.6	119	33.8	5	3.5	3	2.1	142	27.1
	Period 2	6	10.6	65	89.0	-	-	2	2.7	73	25.4
3	Teaching Staff										
	Period 1	5	7.3	52	75.4	7	10.1	5	7.3	69	20.8
	Period 2	6	15.5	28	73.7	1	2.6	3	7.9	38	13.1

44 Table 4. Time Spent on Different Category of Questions

SN	Category of Reader	Time Spent on Questions (See Table 2)							
		Availability of document		Locating document		Specific subject query		Guidance	
		Min	%	Min	%	Min	%	Min	%
1	Postgraduate Student	72	29	1,286	61	88	30	103	48
2	Research Scholar	116	47	571	27	40	14	43	20
3	Teaching Staff	61	24	247	12	64	56	69	32
	Total	248		2,104		292		215	

45 Table 45. Time Spent on Questions of Different Categories of Readers

SN	Category of Reader	Time Spent on Reader (See Table 3)									
		Availability of document		Locating document		Specific subject query		Guidance		Total	
		Min	%	Min	%	Min	%	Min	%	Min	%
1	Postgraduate Student	72	4.6	1,286	83.0	88	5.7	103	6.7	1,549	56.1
2	Research Scholar	116	15.0	571	74.0	40	5.0	43	6.0	770	27.9
3	Teaching Staff	61	14.0	247	56.0	64	14.0	69	16.0	441	16.0

5 OBSERVATIONS

51 Total Number of Questions

The total number of short range questions in the sample for the two periods was 773. Of these, about 63 per cent occurred in Period 1, and about 37 per cent in Period 2. In Period 1, in connection with the subjects of the courses of studies, the postgraduate students make extensive use of the textbooks and associated reading materials available in the library. Similarly, the research scholars make good use of the library with regard to the choice of the subject for research, and the study of the state-of-art and trend of research is the subject chosen. In Period 2, both these categories of readers would have settled down to their studies, as it were, having already selected during Period 1 a good proportion of the documents to be perused. Hence, perhaps, the smaller number of short range questions in Period 2 as compared to that in Period 1.

52 Comment on Table 2

521 Availability of Document

In Period 1, over 83 per cent of the questions on the availability of document were put by postgraduate students, and research scholars. It dropped to 60 per cent in Period 2. This pattern may be explained as follows: In Period 1, a large proportion of each of the above two groups of readers will consist of persons newly admitted to the courses and not familiar with the institutions library facility. By November, that is, beginning of Period 2, some of them would have become acquainted with the use of the catalogue and other tools for getting information on the availability of documents.

In Period 2, the percentage of questions on the availability of documents put by the teaching staff increased nearly two and a half times that of Period 1. In Period 2, the teaching staff may have to help the students in the use of documents relating to the subjects of the assignments etc. Further, for their own research work, they would require information on the availability of different kinds of documents. Often, they ask the question over the telephone or through a note.

522 Locating Document

There has been little change in the pattern of incidence of requests for locating documents by postgraduate students and research scholars in the two periods. This may imply that such readers continued to have some difficulty in locating for themselves the documents needed. They might not have become adequately familiar with the disposition of the different collections in the library, and with the use of the bay guides, gangway guides, shelf guides, etc. Intensive initiation of readers and provision of a hand-out such as a "library guide" may improve the situation.

523 Specific Subject Query

The incidence of questions on specific subjects put by postgraduate students in Period 2 was about two and half times that in Period 1. This pattern may be a result of the fact that the postgraduate students, after reaching some stage in the different courses in Period 1 would, in Period 2, be working on different assignments requiring the use of documents.

In the case of the teaching staff, the percentage of questions on specific subjects in Period 1 was more than double that in Period 2. In Period 1, a teacher may require information on specific subjects of his own research, the subject of research of the research scholars, and on the subjects of the course, with which he may be concerned.

524 Guidance

The percentage of requests for guidance in the use of reference books etc, was the highest with the postgraduate student and least with the research scholar. The pattern is of the usual kind. The low figure for the research scholar is due to the fact that he would have already learnt something about the use of reference sources earlier as a graduate and postgraduate student. Most of the teaching staff have to be frequently helped in the use of reference resources whether they had earlier used them or not. The reference staff may also feel obliged to help the teacher to a comparatively greater extent than in the case of the research scholar.

53 Comment on Table 3

531 Postgraduate Student

There was practically no difference in the pattern of incidence of the different kinds of questions put by postgraduate students during the two periods. Nearly 92 per cent of the requests was for help in locating documents. This per centage was also the highest in the case of the postgraduate students as compared with all the three categories of readers asking for such help. Postgraduate students take a few months after their admission to become adequately familiar with the library tools and with the disposition of the collection.

532 Research Scholar

Here again, there was practically no difference in the pattern of incidence of the different kinds of questions put by research scholars during the two periods, except that in Period 2, there were no specific subject queries. The incidence of requests for help in locating documents was the highest (about 86 per cent), although it is less than that in the case of the postgraduate students. It is expected that the research scholar would become familiar with the library while doing his postgraduate courses, and is, therefore, in a better position to help himself than the postgraduate student.

The percentage of questions on availability of documents put by the research scholars is nearly five times that put by postgraduate students. This also conforms to the expected pattern. The research scholar might select the various documents referred to in reviews, bibliographies etc. on the subject of his proposed research. He would, therefore, like to know the availability of some of the documents in the library.

533 Teaching Staff

In the case of the teaching staff also, the request for help in locating documents had the highest incidence (about 75 per cent) among all types of questions. However, unlike in the case of the postgraduate student and research scholar, the pattern of incidence of questions on availability of documents and on specific subjects put by the teaching staff did not remain at the same level in the two periods. For instance, the percentage of questions on availability of document in Period 2 was more than double that in Period 1; and the percentage of specific subjects query in Period 1 was nearly five times that in Period 2. The likely reasons for this pattern have been mentioned in Sec 521 and Sec 523.

It is also worth noting that the teaching staff use the Departmental Library, where advanced textbooks, monographs, and frequently consulted reference books are available. Further, current issues of selected periodicals are sent to the Departments and used there for about a week. Indexing and abstracting periodicals, such as Chemical abstracts and Biological abstracts, which are usually used by research scholars and teachers from different departments are available for use in the Central Library only.

534 Overall Pattern

The total of 773 questions in the sample studied was shared in the ratio 1 : 2 : 4, by the teaching staff, research scholars, and postgraduate students respectively.

54 Comment on Table 4

541 Availability of Document

Out of the total time of a little over four hours spent on answering questions on availability of documents put by all categories of readers, nearly 50 per cent was spent on those by research scholars. The time spent on such questions put by the postgraduate students and the teaching staff was about

25 per cent for each group. The research scholars have obviously a greater need to use the library than the postgraduate students who may be requiring largely a few prescribed reading materials. The teaching staff have departmental library failities. These facts may explain the particular pattern of sharing of time mentioned above.

542 Locating Document

Over 60 per cent of the time spent on requests for locating documentswas given to the postgraduate students. The research scholars received less than half, and the teaching staff about one fifth of the time received by the postgraduate students. The teaching staff would have become familiar with the library. And further, they also have departmental library facility. The research scholar would, to a much greater extent than the postgrduate student, be able to help himself in locating documents. These factors may explain the particular pattern of sharing of time mentioned above.

543 Specific Subject Query

The research scholar gets the least share of the time (14 per cent) spent by the library staff on questions on specific subjects. The postgraduate students get about twice and the teaching staff four times as much of the time given to the postgraduates. The research scholar is expected to search out largely by himself information on the subject of his interest. The postgraduate students would require help from the library staff in connection with the subject of the assignments, projects, etc. The teaching staff would need the help of the reference staff for searching out information on the subjects of their research, on those of the courses conducted by each of them, and on the subject of the invited lectures, speeches, etc. These factors, perhaps, explain the pattern of time sharing mentioned above.

544 Guidance

The pattern of division of time of the reference staff on the requests for guidance in the use of reference and bibliographical sources put by the three categories of users paralleled the pattern of incidence of such questions (*See* Table 2). Therefore, the commentsmade in Sec 524 are equally applicable here also.

55 Comment on Table 5

The pattern of division of the time spent by the reference staff on the different kinds of questions put by each of the categories of readers parallels the pattern of incidence of the different kinds of questions put by each of the categories of readers (*See* Table 3). Therefore, the comments made in Sec 53 and its subdivisions are euqally applicable here also.

56 Other Services

561 Outside Scholars

A few research workers and specialists from outside the institution also receive help on short range reference questions. Table 6 in Sec 562 gives data on the different kind of question answered on eighteen days in Period 1 (July-October 1967).

562 Table 6. Number of Questions and Time Spent

SN	Kind of Question	N	% of 40	Time Spent	
				Min	% of 185
1	Availability of document	8	20	44	24
2	Locating document	24	60	74	40
3	Specific subject query	3	7	24	13
4	Guidance	5	13	43	23
	Total	40	100	185	100

563 Reading Lists and Short Bibliographies

During the period under study, 8 short bibliographies and reading lists on specific subjects were prepared. Each list, containing about 30 entries, took on an average 16 hours for search, selection of documents, and compilation.

6 LIBRARY STAFF AND SUBJECT KNOWLEDGE

61 Criteria for Selection

The personnel doing reference service should preferably share between themselves a background knowledge of the subjects predominantly occurring in the different activities and services of the library. The predominant patternmay be recognised on the basis of the distribution of subjects among the

1 Reference questions;

2 Books and periodicals circulated;

3 Library's holdings of reading material;

and

4 Potential users of the library.

Data on these items, relating to the twelve month period May 1967 - April 1968, are presented in Table 7 in Sec 62.

62 Table 7. Subjectwise Distribution of Holdings, Circulation, Reference Questions, etc. (Percentage)

SN	Main Subject		Potential user			Holdings		Circulation		Reference Question (586)
	CCN	Term	Staff (277)	Student		Book (50,000)	Periodical (3,150)	Book (3,257)	Periodical (150)	
				Res (257)	PG (588)					
1	z	Generalia				2.0	0.9	0.1		2.3
2	2	Library science				0.5	1.5	0.2		
3	3	Book science				0.5		0.3		
4	5	Standardisation					0.2			
5	6	Museology					0.2			
6	A	Natural sciences				1.3	9.5	0.5	10.0	2.7
7	B	Mathematics	5.1	3.5		9.0	6.5	25.0	2.1	16.0
8	C	Physics	4.3	9.3		8.0	5.0	12.0	12.0	14.5
9	D	Engineering	56.0	26.1	74.7	30.0	27.0	30.0	28.0	40.0
10	E	Chemistry	15.5	36.6		8.0	6.5	11.5	24.0	10.0
11	F	Technology	12.3	18.3	23.5	8.0	9.5	6.0	9.0	5.0
12	G	Biology				1.8	3.0	2.0	3.0	1.3
13	H	Geology				1.3	3.0	1.0	0.6	0.7
14	HX	Mining				0.1				
15	I	Botany				0.6	1.0	0.5	1.0	0.3
16	J	Agriculture				1.2	8.5	0.8	–	0.3
17	K	Zoology				0.6	2.0	0.4	0.6	0.1
18	KX	Animal Husbandry				0.1				
19	L	Medicine				2.1	6.0	1.5	4.0	2.3

(Continued)

SN	Main Subject		Potential user			Holdings		Circulation		Reference Question (586)
	CCN	Term	Staff (277)	Student		Book (50,000)	Periodical (3,150)	Book (3,257)	Periodical (150)	
				Res (257)	PG (588)					
20	LX	Pharmacognosy	1.5	2.7		0.5				
21	M	Useful arts				1.2	0.8	0.5		0.3
22	△	Mysticism				0.1		0.2		
23	N	Fine arts				0.7	0.2	0.8		0.1
24	O	Literature				1.3		2.4		0.1
25	P	Linguistics	2.6	3.5		1.7	0.1	0.5		0.5
26	Q	Religion				0.4		0.5		
27	R	Philosophy				0.7		0.9		0.1
28	S	Psychology				2.0	0.8	0.8		0.3
29	T	Education				0.8	0.4	0.3		0.7
30	U	Geography				0.4	0.7	0.5		
31	V	History				0.9	0.4	0.5		
32	W	Political science				0.6	0.2	0.3		
33	X	Economics	2.8		1.8	6.6	5.0	2.0	5.0	2.5
34	Y	Sociology				0.9	1.0	0.2	0.7	
35	Z	Law				0.2	0.1	0.1		

63 Dominant Subjects

It is obvious from Table 7 that the Physical Sciences predominate. Among these, the applied subject Engineering is the most prominent. The data in the columns Holdings-Periodical, and Circulation-Periodical, against the subject Natural Sciences, would cover such periodicals as Nature, Science, Scientific American, and Naturwissenschaften. The actual articles used in the periodicals would fall in one or other of the Main Subjects A to L.

The Biological Sciences (G to LX) are the next most predominant subjects.

Industrial Engineering, Industrial Psychology, and related subjects also show significant incidence.

7 CONCLUSION

71 Academic-cum-Research Character

The analysis of the data collected on short range reference questions confirms the academy-cum-research character of the parent organisation. Usually, in a solely teaching institution such as a college, the more predominant types of reference questions will be requests for guidance and help in the use of the tools of the library, and the library's collection of documents. In a research institution such kinds of questions will be incident to a comparatively much less extent; questions relating to information on specific subjects, and greater dependence of the readers on the bibliographical and documentation services of the library will be the more predominant pattern.

In the library of the institution studied we find the incidence of a mixture of both kinds of reference questions.

72 Predominance of Physical Sciences

The Physical Sciences predominate in the reference questions, documents used by readers, and in the holdings of the library.

73 Unanswered Questions

A record was kept of the short range questions for which answers could not be found within a reasonable period of time. The reasons for not locating the answer may be one or more of the following:

1 There is no suitable document in the library which could answer the particular question. This may be due to either of

11 An inadequacy of the document collection; or

12 The subject of the question being beyond the scope of the library s collection;

2 The document likely to contain the answer to the question is temporarily not available in the library -- for example, it may be on loan;

3 Inadequacy of the tools and techniques such as classification and cataloguing;

4 Inadequacy of the reference staff, in terms of knowledge of subjects, reference books and other documents, techniques of reference service etc;

5 Inadequacy in the communication of the query by the reader to the reference staff. For example,

non-precision of expression and missing the kernel idea on which information is required; and

6 Failure of the reader-librarian dialogue in the precise formulation of the subject of the query.

The information gathered from such an analytical record of the unanswered questions could help in taking suitable steps to correct the fault or inadequacy detected.

8 ACKNOWLEDGMENT

I am grateful to Dr T K S Iyengar, Librarian, Indian Institute of Science, Bangalore, for permission to contribute this paper to the DRTC Seminar (7) (1969).

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DOCUMENT USAGE IN A SPECIALIST LIBRARY: A CASE STUDY.

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Survey of use of documents by specialists is helpful. The interview and questionnaire methods of survey may not be economical for an individual library. The pattern of document usage by specialists in the Central Building Research Institute, Roorkee, was studied through an analysis of the documents cited by them in their research publications. The average age of the documents cited in the CBRI publication was over five. The extent of use of patents and standards was not appreciable although the research at the Institute was mainly in the applied subjects. Some inferences and suggestions for further investigation are made on the basis of the findings.

1 INTRODUCTION

11 Needs of Readers

Documentation service has to be pinpointed, exhaustive, and rendered at optimum cost to meet the exact requirements of readers. A study of the requirements of readers would therefore be helpful. It would help in:

1 Recognising the deficiency in the existing service;

2 Determining the extent to which improvements can be made in a given set of circumstances;

3 Determining the cost, if any, needed to achieve the improvement;

4 Document selection to suit the needs of readers;

5 Weeding out documents that do not meet the needs of readers; and

6 Effecting economy in space, time, manpower, and money.

12 Survey of Reader Behaviour

There have been a number of studies on the behaviour of readers in using document finding systems. Survey technique, operations research, etc, have been used for the purpose. The survey is usually made either:

1 Through direct contact with readers and eliciting answers to various carefully framed questions; or

2 Issuing a questionnaire and analysing the replies received; or

3 Using a combination of 1 and 2.

Such a study would involve considerable organisational work, time, and manpower. It is also costly. Further, in the questionnaire type of survey, the response from the user may not always be adequate for applying statistical calculus to the data and make valid inferences thereof.

2 STUDY OF CITATIONS OF DOCUMENTS

In our present study, we have tried to know the needs of readers indirectly. It is based on a study of the citation in their research papers published in different periodicals.

21 Coverage of Documents

The study is confined to the bibliographical references (citations) made by the specialists --

scientists and engineers -- of the Central Building Research Institute (CBRI) in the articles published by them during the period 1964 to 1968 inclusive. For each year of the study, 20 papers were selected. Each paper dealt with one or the other of major subjects of interest to CBRI -- namely, Building Materials (= BM), Efficiency of Building (= EB), Building Process, plant and productivity (= BP), and Soil Engineering (= SE).

22 Data on Documents Cited

Table 1 gives data on the different kinds of documents cited in the papers examined.

221 Table 1. Kinds of Documents Cited

SN	Kind of Document	N of Citations
1	Article in periodical ..	482
2	Book	100
3	Conference Proceedings ..	91
4	Report	55
5	Patent	13
6	Standard specification ..	11
7	Theses	3
8	References without full bibliographical details ('unpublished' and 'to be published' kinds and documents without mention of year of publication, etc).	39
	Total	794

3/6 ANALYSIS

3 CITING OF INDIAN AND FOREIGN DOCUMENTS

The data on citations in 100 papers written by the specialists in CBRI, of which 68 were published in Indian periodicals and 32 in foreign periodicals, are presented in Table 2 (See next page).

311 Annotation

The number of citations in the 68 articles published in Indian periodicals consisted of 142 Indian and 340 foreign documents. The corresponding data for the 32 articles published in foreign periodicals are 87 and 225. It would appear that the citing of documents published in foreign periodicals is on the higher side in the papers published in foreign periodicals as compared to the citing of foreign documents in the papers published in Indian periodicals.

32 Self-Reference

The number of citations to one's own earlier work is greater in articles published in foreign periodicals as compared with those published in Indian periodicals. The number of such self-references in Indian periodicals is 75 and that in foreign periodicals, is 66. It should be remembered that 68 articles were published in Indian periodicals and only 32 in foreign periodicals.

4 CITATIONS IN RELATION TO TIME

41 Data

The data on the number of citations to articles, books, conference proceedings and reports (See Table 1 in Sec 221) were further sorted out according to the year of publication of each of them. Fig 1 and 2 visualise the analysed data (See Appendix).

31 Table 2. Citation of Indian and Foreign Periodicals and Self-References

FP = Foreign Periodical FR = Foreign Reference IP = Indian Periodical
IR = Indian References SR = Self-Reference

Subject	Particulars	1964		1965		1966		1967		1968		Total	
		IP	FP	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
SE	N of Papers	4	0	2	2	3	1	7	2	2	0	18	5
	IR ..	3	0	1	5	11	2	23	8	5	0	43	15
	FR ..	16	0	3	3	10	10	36	8	14	0	84	21
	SR ..	2	0	1	2	6	0	11	7	3	0	23	9
EB	N of Papers	1	5	6	3	3	0	5	2	9	0	24	10
	IR ..	1	26	7	12	9	0	15	2	16	0	48	40
	FR ..	3	36	28	15	30	0	19	20	33	0	113	71
	SR ..	1	20	6	7	5	3	3	0	13	0	28	27
BM	N of Papers	1	7	3	4	7	2	2	1	5	2	13	16
	IR ..	2	11	5	10	16	2	3	5	14	2	40	30
	FR ..	3	51	18	48	51	24	3	3	32	7	107	133
	SR ..	1	17	4	8	13	1	0	4	5	0	23	30
BP	N of Papers	2	0	0	0	3	1	1	0	2	0	8	1
	IR ..	0	0	0	0	3	2	6	0	0	0	9	2
	FR ..	9	0	1	0	12	0	6	0	10	0	38	0
	SR ..	1	0	0	0	0	0	0	0	0	0	1	0

42 Calculation of Values of Parameters

d = Deviation about the assumed mean. f= Frequency. x = Year number

421 Table 3. Data for Calculating the Mean Time (M) and Standard Deviation (σ)

	Articles				Books				Reports			
x	f	d	fd	fd^2	f	d	fd	fd^2	f	d	fd	fd^2
1	51	-8	-408	3264	8	-8	-64	512	7	-8	-56	448
2	39	-7	-273	1911	5	-7	-35	245	5	-7	-35	245
3	38	-6	-228	1368	7	-6	-42	252	4	-6	-24	144
4	40	-5	-200	1000	8	-5	-40	200	3	-5	-15	75
5	31	-4	-124	496	6	-4	-24	96	3	-4	-12	48
6	29	-3	- 87	261	4	-3	-12	36	1	-3	- 3	9
7	29	-2	- 58	116	7	-2	-14	28	2	-2	- 4	8
8	26	-1	- 26	26	7	-1	- 7	7	2	-1	- 2	2
9	19	0	0	0	2	0	0	0	2	0	0	0
10	18	1	18	18	6	1	6	6	2	1	2	2
11	16	2	32	64	4	2	8	16	2	2	4	3
12	14	3	42	126	4	3	12	36	2	3	6	18
13	14	4	56	224	4	4	16	64	4	4	16	64
14	11	5	55	275	2	5	10	50	4	5	20	100
15	10	6	60	360	5	6	30	180	3	6	18	108
16	7	7	49	343	3	7	21	147	3	7	21	147
17	15	8	120	960	8	8	64	512	1	8	8	64
18	23	9	207	1863	5	9	45	405	3	9	27	243
19	24	10	240	2400	4	10	40	400	2	10	20	200
20	24	11	264	2904	1	11	11	121	1	11	11	121
21	4	12	48	576								
	482		-213	18555	100		25	3313	56		2	2054

Contd ...

421 Table 3. Data for Calculating the Mean Time (M) and Standard Deviation (σ)

Proceedings of Conference					Total			
x	f	d	fd	fd^2	f	d	fd	fd^2
1	7	-8	-56	448	73	-8	-584	4672
2	9	-7	-63	441	58	-7	-406	2842
3	6	-6	-36	216	55	-6	-330	1980
4	8	-5	-40	200	59	-5	-295	1475
5	4	-4	-16	64	44	-4	-176	704
6	6	-3	-18	54	40	-3	-120	360
7	4	-2	- 8	16	42	-2	- 84	168
8	8	-1	- 8	8	43	-1	- 43	43
9	3	0	0	0	26	0	0	0
10	5	1	5	5	31	1	31	31
11	6	2	12	24	28	2	56	112
12	7	3	21	63	27	3	81	243
13	7	4	28	112	29	4	116	464
14	4	5	20	100	21	5	105	525
15	1	6	6	36	19	6	114	684
16	2	7	14	98	15	7	105	735
17	1	8	8	64	25	8	200	1600
18	1	9	9	81	32	9	288	2592
19	1	10	10	100	31	10	310	3100
20	1	11	11	121	27	11	297	3267
21					4	12	48	576
	91		-101	2251	729		-287	26173

422 Table 4. Data for Calculating Mean Time (M) and Standard Deviation (σ) for Subjects

	BM				SE			
x	f	d	fd	fd^2	f	d	fd	fd^2
1	22	-8	-176	1408	15	-8	-120	960
2	16	-7	-112	784	17	-7	-119	833
3	15	-6	- 90	540	16	-6	- 96	576
4	20	-5	-100	500	13	-5	- 65	325
5	15	-4	- 60	240	8	-4	- 32	128
6	15	-3	- 45	135	8	-3	- 24	72
7	16	-2	- 32	64	9	-2	- 18	36
8	19	-1	- 19	19	7	-1	- 7	7
9	20	0	0	0	5	0	0	0
10	11	1	11	11	8	1	8	8
11	8	2	16	32	9	2	18	36
12	8	3	24	72	9	3	27	81
13	8	4	32	128	8	4	32	128
14	11	5	55	275	6	5	30	150
15	9	6	54	324	4	6	24	144
16	7	7	49	343	5	7	35	245
17	11	8	88	704	4	8	32	256
18	13	9	117	1053	2	9	18	162
19	23	10	230	2300	6	10	60	600
20	21	11	231	2541	2	11	22	242
21	1	12	12	144	0	12	0	0
	279		285	11617	161		-175	4989

Contd ...

422 Table 4. Data for Calculating Mean Time (M) and Standard Deviation (σ) for Subjects

	EB				BPPP			
x	f	d	fd	fd^2	f	d	fd	fd^2
1	35	-8	-280	2240	1	-8	-8	64
2	24	-7	-168	1176	1	-7	-7	49
3	22	-6	-132	792	2	-6	-12	72
4	24	-5	-120	600	2	-5	-10	50
5	19	-4	- 76	304	2	-4	- 8	32
6	15	-3	- 45	135	2	-3	- 6	18
7	15	-2	- 30	60	2	-2	- 4	8
8	17	-1	- 17	17	0	-1	0	0
9	10	0	0	0	1	0	0	0
10	9	1	9	9	3	1	3	3
11	10	2	20	40	1	2	2	4
12	9	3	27	81	1	3	3	9
13	11	4	44	176	2	4	8	32
14	4	5	20	100	0	5	0	0
15	5	6	30	180	1	6	6	36
16	2	7	14	98	1	7	7	49
17	10	8	80	640	0	8	0	0
18	17	9	153	1377	0	9	0	0
19	1	10	10	100	1	10	10	100
20	3	11	33	363	1	11	11	121
21	0	12	0	0	3	12	36	432
	262		-428	8488	27		31	1079

423 Calculation of Mean and Standard Deviation

The following equations were used to compute the Mean and Standard Deviation:

$$M = A + \frac{\Sigma fd}{\Sigma f} i \quad \text{and} \quad \sigma = i \sqrt{\frac{\Sigma fd^2}{\Sigma f} - \left[\frac{\Sigma fd}{\Sigma f}\right]^2}$$

where M = Average Time in years

$d = \frac{X-A}{i}$ where A = Assumed Mean (9 in this case)
i = Interval (1 year in this case).

424 Table 5. Average Time (in years) for Documents

Statistical Constant	Articles	Books	Reports	Conference Proceedings
M	8.56	9.25	9.04	7.9
σ	6.2	5.8	6.0	4.5

Overall values of M and σ are 8.61 and 6 respectively.

425 Table 6. Average Time (in years) for Subjects

Statistical Constant	Subjects			
	BM	SE	EB	BP
M	10.02	7.91	7.37	10.15
σ	5.6	5.5	5.4	6.2

5 OBSERVATION

51 Fig 1 shows that the scientists at CBRI have used a larger number of documents published earlier than five years than those published within the immediately preceding five years of the year of publication of the papers citing them. The number

of documents in the former category is about 1.5 to 2 times the number of documents in the latter category.

52 This finding may have several implications such as the following:

1 In respect of the coverage (in terms of years) of documents in the bibliographies prepared for the use of the readers;

2 Suggest an examination whether the

21 Documentation service -- particularly the services meant to keep the scientists abreast of the current developments in their respective subject-fields are being effectively utilised;

22 Observed pattern in document usage is a peculiarity with the subjects investigated at CBRI; and

23 Projects undertaken by the research workers in CBRI were already worked upon some years ago elsewhere.

53 Only ten per cent of the documents cited were those published within one year immediately preceding the year of publication of the papers citing them. As compared to this, most of the citations in articles by foreign authors published in a foreign periodical are to documents published within the five years immediately preceding the year of publication of the papers citing them. The delay in the receipt in India by surface mail of the foreign periodicals -- which are the ones mostly cited in the CBRI papers -- may be one of the reasons for this state of affairs in India (1).

54 Fig 2 indicates that the number of documents cited decreases as the difference in the year

of the citing document and of the cited document increases. However, in the last four years -- 16th to 20th year --, there is a slight upward trend in the number of citations.

6 USE OF STANDARDS AND PATENTS

61 Standards

The subjects of the papers we have examined are all of the "applied" category. Therefore, the number of citations to standards is expected to be high. However, there were only 11 citations of standards, 2 of which were foreign.

62 Patents

621 Table 7. Dates of Patents Cited: Country-wise

Year	W Germany	E Germany	India	Japan	USA
1964	-	-	-	-	-
1965	1957 1962	-	1962 1962	1961	1962
1966	-	-	-	-	-
1967	-	-	2 patents (without year)	-	-
1968	1933 1951	1961	-	-	1937 1944

The number of patents cited is quite small. Three of the patents cited were by specialists in the field of Building Materials. Three citations were to patents taken by the authors of the papers, the subjects being Soil Engineering 2, and Efficiency of Buildings 1. It is obvious that the specialists have to be made better aware of the sources of information about patents and about the availability of patents.

7 OTHER POINTS NOTED

71 Nearly 40 per cent of the entries in the bibliographical reference were deficient for one reason or other. For example, the year of publication of the host document is not given in many. Editors of periodicals should insist on standard practices in citation. The librarian could check the citations in the documents sent for publication from his organisation and also guide the authors in the standard practice of bibliographical references.

72 Almost all the references have been made to the original sources even when the author had not read the original because it was in a foreign language with which he is not familiar, and therefore, got the information from secondary sources such as an abstracting periodical. Only one author quoted Chemical abstracts in citing a patent.

73 In referring to a standard, the existence of revision slips and revised version of the standard should be brought to the notice of the specialist. The chances of citing an old standard when a revision exists are greater in the case of foreign standards.

8 ACKNOWLEDGMENT

This paper is contributed to the DRTC Seminar (7)(1969) with the permission of the Director, CBRI.

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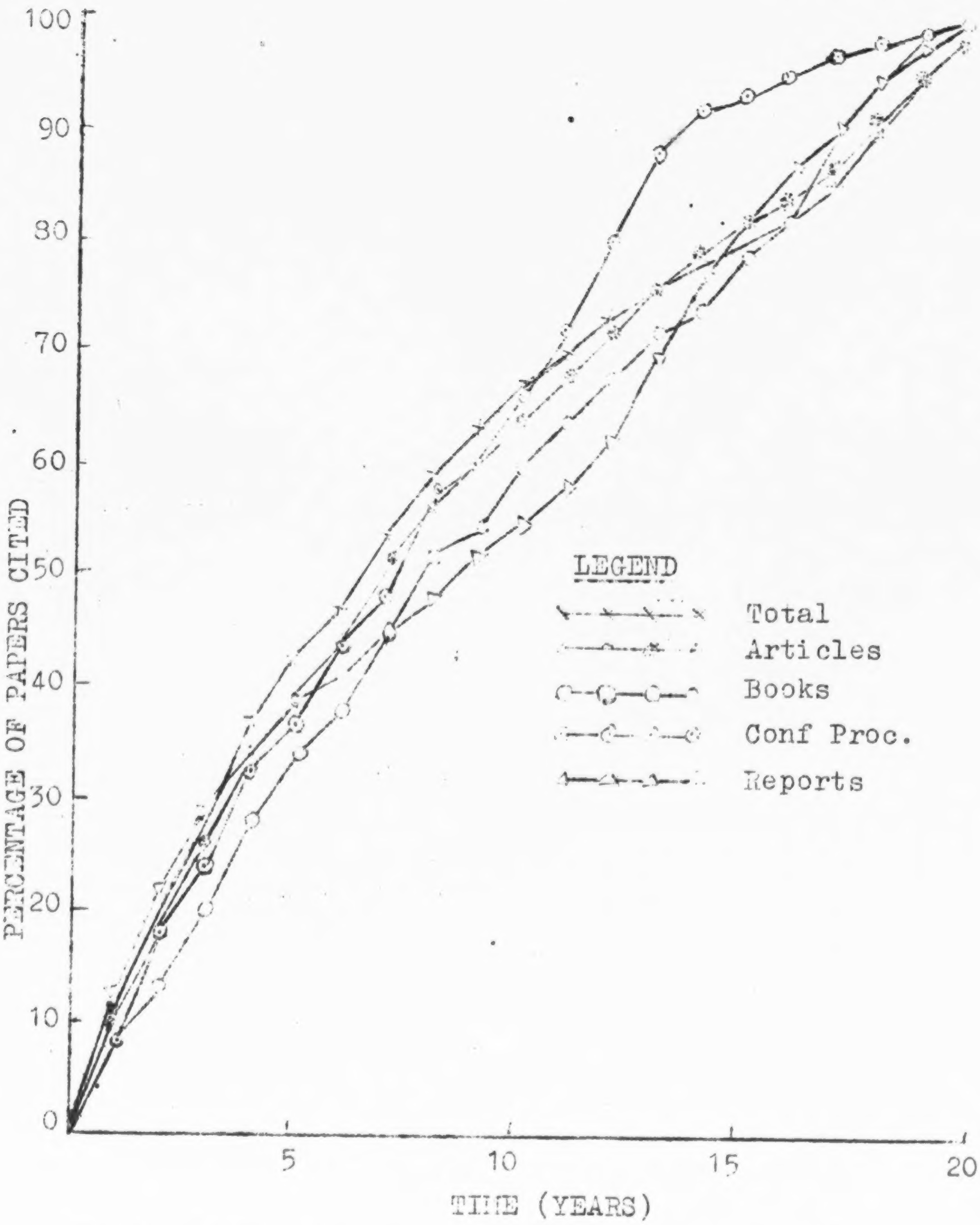

FIG 1. CUMULATIVE FREQUENCY CURVES SHOWING THE PERCENTAGE OF ARTICLES CITED IN TWENTY YEARS

92 APPENDIX

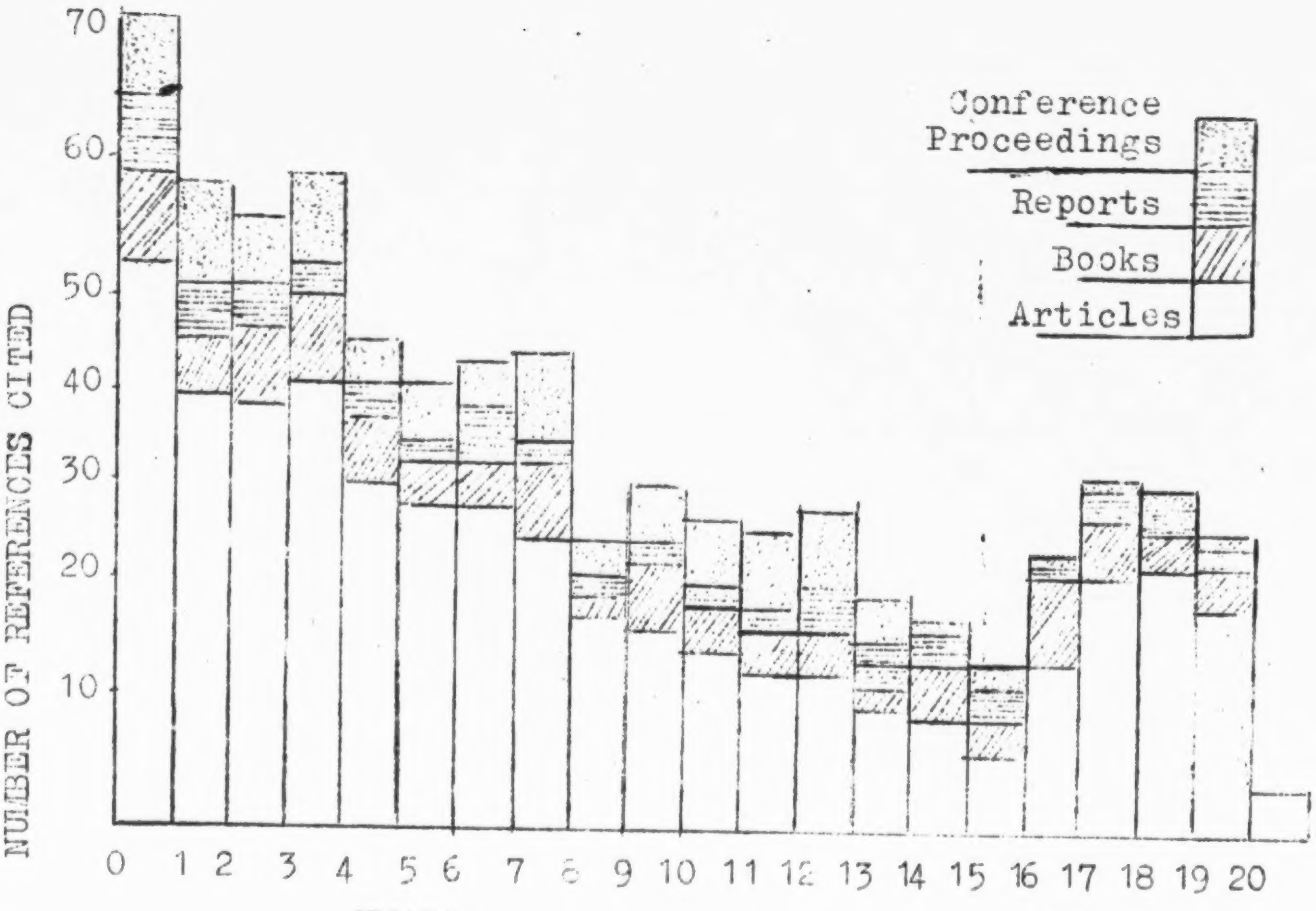

FIG 2. SUB-DIVIDED HISTOGRAMS SHOWING REFERENCES CITED CATEGORY AND YEARWISE

DRTC Seminar (7)(1969). Paper JA.

GROWTH OF MULTIPLE AUTHORSHIP.

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The change from 'little science' to 'big science' has either resulted in or has been made possible by a shift from solo-research to team-research as reflected in single and multiple authorship of papers. The reasons for single and multiple authorship are compounded of several variables such as institutional policy, financial support, nature of research -- observational, experimental, and theoretical --, subject of investigation, collaboration pattern, and personal prejudices of the research workers. Data on the pattern of distribution of single and multiple authorship in papers in mathematics, astronomy, radioastronomy, pulsar, chemistry, biomedicine, bacteriology, and sociology, are presented and graphically illustrated. Compares the data in the different subject-fields and infers the trend in some of the cases. Three different patterns of authorship are suggested: (1) Astronomy and geology papers; (2) Chemistry Papers; and (3) Biomedical papers -- representing different phases of a logistic growth curve.

1 INTRODUCTION

11 Multiple Authorship and Big Science

Clearly an understanding of the factors involved in the working of the scientific community would be of some value in the design and implementation of the services devoted to it. The productivity of the scientific community is subject to a number of factors, one of which is the great increase in multiple authorship during this century when the expansion in science has been so marked.

It would, therefore, seem reasonable to suggest that the change from 'little science' to 'big science' has either resulted in or has been made possible by a shift from single to joint and multiple authorship. The constraints and reasons for single and multiple authorship are clearly compounded of numerous variables including institutional policies, nature of research and personal prejudices among many others. There appears to be little or no data on some of these factors.

12 Scope of the Paper

The approach taken here is an examination of the distribution of multiple and single authorship in different subjects. Some of the data presented is the work of other authors and this is summarised in the following sections for comparison with the results I have obtained for astronomy and geology.

2 DISTRIBUTION OF SINGLE AND MULTIPLE AUTHORSHIP IN DIFFERENT SUBJECTS

21 Chemical Papers

For chemistry, Price (7) gives data from Chemical abstracts over a span of fifty years. These are the results of an unpublished investigation by L Badesh and show that the trend towards multiple authorship is increasing exponentially and that the percentage of three-author papers, for instance, is increasing more rapidly than two but less rapidly than four or more authors per paper (Fig 1 in Sec 7.1).

In a footnote to the section on multiplicity of authors, Price gives data from a letter by W R Utz (1962). This gives the percentage of papers having joint authors from Mathematical reviews over a span of twenty years. Data are also given for three journals from USA since 1920. Unfortunately, only a few data are given and whilst they show a clear trend towards multiple authorship, they are insufficient to construct a reliable graph to compare with other figures. The data from periodicals are particularly erratic.

22 Biomedical Papers

Biomedical papers have been examined by Clarke. The data from his paper of 1964 (1) show the distribution of authorship in papers presented at the annual meetings of the Federation of American Societies for Experimental Biology and covers the period 1934 to 1963. There are striking differences between the results obtained by him and those by Price. Clarke used statistical methods to detect trend. Up to 1946, the curves parallel those for data from *Chemical abstracts* (except those for two authors) -- that is, there is a sharp increase in multiple authorship, but little or no trend is detectable from 1947-63. During this period, the data vary about the mean to a much greater extent than previously. The expanded analysis in Clarke's paper of 1967 (2) confirm a downward trend in single-author papers with an increase in two-, three-, four-, and more author papers.

221 Bacteriology Papers

In 1965, Kull gave figures for multiple authorship from the *Journal of bacteriology* covering the period 1935 to 1963 (6), the same time-span as Clarke's work. Data are given for 1935, 1945, 1950, 1954, 1959, and 1962, and show no consistent change as regards two- and three-author papers, but a decline in the single-author papers. A trend to four- and more author papers during the past ten to twelve years was also noted. The number of papers in this single periodical is limited (30-80 papers per year). Therefore, the data vary about the mean considerably, but nevertheless, they would appear to be of the same order as those obtained by Clarke for biomedical papers.

23 Sociology Papers

Hirsch and Singleton (4) conclude that in the field of sociology, there is an observable but not consistent trend towards multiple authorship in two periodicals in sociology. They note that the pronounced increase occurs earlier in the 'establishment' periodical.

24 Information Exchange Group

Price and Beaver (8) investigated multiple authorship in the Information Exchange Group I (IEG I) on oxidative phosphorylation and terminal electron transport. They analysed 533 memos and found an average of 2.23 authors per paper over a time-span of five years.

25 Table 1. Summary

Note.- Unless otherwise indicated, the data are from this paper.

Percentages given in square brackets have been determined by interpolation from the graphs.

Subject	Persentage of Single Authors				
	1910	1934	1940	1960	1963/4
Bibliography and Index of Geology	-	89	[88]	[78]	73
Astronomischer Jahresbericht	95	89	[86]	[73]	68
Mathematical Reviews (Price 1963)	-	-	94	79	-
Radioastronomy	-	-	-	60	55
Chemical abstracts (Price 1963)	[82]	[72]	[67]	[40]	[30]
Biomedicine (Clarke 1964)	-	34	[32]	[20]	18 (1963)
Bacteriology (Kull 1965)	-	47 (1935)	-	-	18 (1963)

3 ASTRONOMY PAPERS

31 Procedure

Trends in multiple authorship in astronomy for the period 1900 to 1965 were examined by an analysis of the Astronomischer jahresbericht, which is generally considered to be the most complete indexing/abstracting service for this subject. Two annual volumes per decade were analysed completely. Personal authors only were counted and no distinction was made between original research work and books or review work.

32 Data

The results, recorded graphically in Fig 3 in Sec 73, show a trend towards multiple authorship similar to those found by Price for Chemical abstracts but with a much slower rate of change.

33 Geology

Data were also obtained for geology in the same way using the Bibliography and index of geology exclusive of North America (Fig 4 in Sec 74). There is a remarkable similarity between the graphs obtained for astronomy and geology, as represented in these two abstracting periodicals, both in the rate of change and the actual percentages of single and multiple authors through each decade.

34 Radio-Astronomy Papers

Data on the increase in multiple authorship were also collected through Astronomischer jahresbericht on a relatively modern branch of astronomy -- radio-astronomy (excluding radio sources within the solar system) -- from 1947 to 1966. This shows a more rapid increase and greater level of multiple authorship in radio-astronomy than is average for the subject. The points on the graph (Fig 5 in Sec 75) tend to fluctuate because of the relatively small numbers involved.

35 Papers on Pulsar

It is also interesting to note that in the papers on pulsars, celestial objects whose discovery was announced in 1968, there is a dramatic difference between the ratios of single, joint, and multiple authors for papers reporting observations and those dealing with theoretical aspects. The data are given below. Only the literature published for the first six months following the discovery was analysed, so that it is possible that this short time-span may have some effect on the percentages.

	Percentage N of Authors			
	1	2	3	More than 3
Theoretical ..	55	30	5	5
Observational ..	0	56	20	24
Total ..	30	44	12	4

(Total number of papers examined = 50, of which 20 were theretical, 26 predominantly observational, and 4 of a mixed category)

36 Radioastronomy as a Big Science

Radioastronomy, which includes the study of pulsars, might well be considered as "big science". It is a relatively new, but rapidly expanding science, which involves complex and costly instrumentation. The increase in multiple authorship in this field is far more rapid than in astronomy as a whole and the correlation of expensive instrumentation with multiple authorship is seen in the striking difference between the observational and theoretical papers in the papers on pulsars.

37 Trend

371 Astronomy and Geology

If all the data available are plotted on graphs in the same way as the data for Chemical abstracts the results could be more easily compared. The similarity of the graphs for Astronomischer jahresbericht and the Bibliography and index of geology has already been pointed out: multiple authorship is increasing but the majority of publications is by single authors. The three figures for Mathematical reviews indicate a similar trend and the percentage of single authors is of the same order as the above.

372 Chemistry

The graph for Chemical abstracts presents a very different picture. There is a very rapid increase in multiple authorship. Even in 1910, the trend away from single author to two-author is well established as compared with astronomy (See Table 1 in Sec 25). Also the point of maximum curvature for three and 'four plus' authors occurs earlier in Chemical abstracts, between 1920 to 1930 and 1925 to 1935, as compared with 1935 to 1945 and c1950 for Astronomischer jahresbericht.

373 Biomedical Papers

On the other hand, the graph for biomedical papers (Fig 2 in Sec 72) has a very much smaller slope than that for Chemical abstracts, but combined with a high proportion of papers (77 per cent) by joint or multiple authors. It should be noted that single authorship in this field was considerably lower than in the subjects mentioned above as far back as the 1930's. The figures given for the Journal of bacteriology are not sufficient to draw an accurate graph, but if plotted, they are very similar to the general pattern obtained for biomedical papers.

4 COMPARATIVE STUDY

41 Multiplicity Index

In Fig 6 and 7 in Sec 76 and 77 respectively, the data for astronomy and geology are the same but presented differently to reduce the graph to a single line. Using this method, an overall picture for single and multiple authorship can be more easily compared. The parameters used are the logarithm of the multiplicity index against time.

$$\text{Multiplicity index} = \frac{\%\ 1\ \text{author} + 2(\%\ 2\ \text{authors}) + 3(\%\ 3\ \text{authors})\ ..}{100}$$

42 Problems in Comparison Studies

Two other points should be noted about the graphs. Firstly, the data on which they are based, are not strictly comparable. Those used by Clarke and Kull would be about original research papers at least for the most part, whilst the data for astronomy and geology include the original research papers and reviews of books, etc covered by the abstracting periodicals concerned, though the percentage of books etc in the abstracting periodicals is probably small compared to that of original research papers. Kull compared the data for notes and articles in the Journal of bacteriology and no significant difference was found as regards multiple and single authorship

Secondly, Clarke notes that the break in slope occurs at about 1946 for the biomedical papers. The steep part of the curve, he suggests, might be due to pressures during war time promoting a rapid increase in multiple authorship. War-time certainly lowered the productivity of scientists as measured by the number of publications. This can be seen for instance in a graph based on articles from ten unspecified scientific periodicals (5), which also shows the proportion of single and joint or multiple authors. The curves for single- and two-author papers from the Bibliography and index of geology also show what might be interpreted as a break between 1940 and 1945. However, the number of points on the graph is insufficient to draw any firm conclusion, especially as at this time the work done over several years was published in one volume and not annually. Similarly, the data for the Journal of bacteriology might parallel the trend in biomedical papers.

5 OTHER ASPECTS OF MULTIPLE AUTHORSHIP

51 Some Influencing Factors

Some of the factors involved in multiple authorship have been investigated and it would seem appropriate to review the evidence here before trying to draw any conclusions about the influence of the subject matter on authorship and collaboration.

511 Financial Support

The relationship between financial support and multiple authorship has been investigated by Hirsch and Singleton. They found that the average number of authors for financially supported work reported in periodicals in Sociology was 1.35 as against 1.20 for unsupported. Clarke in 1967 (2) followed up his work on multiple authorship in the biomedical papers with a further analysis of authorship in the societies which go to make up the Federation (FASEB). He ranked the societies over a number of years with respect to multiple authorship and found that there was a significant correlation with non-sponsorship. As a result of his survey, he concluded that each society showed an individual pattern as regards multiple authorship.

512 'Popularity' of Subject

A factor which might perhaps be taken into account in considering relatively narrow subject fields is that a field which attracts few people will have less potential for multiple authorship than a popular field which attracts large numbers of workers into it. Some figures I have obtained for thermodynamics from 1900 to 1960's would be compatible with this supposition. Figure 8 in Sec 78 shows that during the 1930's when thermodynamics was more popular than it is now (as measured by the number of papers produced per year), the level of multiple authorship in the field was high, whereas now despite the general increase in multiple authorship in physics as a whole, it appears to be declining in thermodynamics.

513 Utilisation of Man-Power

Price discusses the reasons for the increase in multiple authorship along with the data for Chemical abstracts. He regards it as a rationalisation of the manpower shortage in a rapidly expanding science. Fractional authorship is thus the means of utilising the vast majority of scientists with low or moderate productivity to the best advantage. Productive scientists on the other hand tend to become heads of groups 'visible or invisible'. This model is tested in a later paper by Price and Beaver, in which it is shown that those with a high productivity measured in terms of memos to the IEG, are also those with a high degree of collaboration. The overall picture is of a core of active researchers within a large floating population of people who collaborate with them.

514 Collaboration Pattern

The above is different from the more conventional view implicit in a number of studies, where multiple authorship is primarily regarded as a means to utilise the different skills and pairs of hands to tackle a problem which would otherwise be too big to perform. In certain types of collaboration, this undoubtedly holds true; for instance, certain types of modern instrumentation require a number of people to run an experiment. Hagstrom gives an account of the scientific community based on some ninety interviews he conducted with scientists and science students, in which the question of teamwork or collobo-ration was raised. The answers and attributes of scientists to this is very illuminating and it would seem that there is a fundamental difference between what Hagstrom terms 'free collaboration', where participants collaborate more or less equally on problems of common interest and in certain types of group research where scientists may tend to become little more than high grade technicians. Johnson, in discussing the optimum size of a group, points out the inter-group communication is a limiting factor in the efficient functioning of the group, but his optimum size of between 4 and 7 people fails to take into account the different types of collaboration where this factor may not be so important.

6 CONCLUSION

61 Influence of Subject Matter

Two hypotheses on the reasons for the large increase in multiple authorship as opposed to single authorship, have been mentioned in the preceding sections along with some of the factors involved. Bearing these points in mind, the influence of the subject matter will now be considered using the data given in the first part of the paper. The graphs (Fig 1 to 5) fall into three groups. Astronomy and geology and possibly mathematics are characterised by a high proportion of single authors and a slow but increasing trend to joint and multiple authorship. On the other hand, the results from the Chemical abstracts over the same period of time show a far more rapid increase in multiple authorship and single authors now make up only about 30 per cent of the total. A very different pattern is found for biomedical papers. Unfortunately, the figures do not go back further than 1934, but a sharp increase in multiple authorship is followed by a relatively 'flat' average curve in which it is difficult to detect any trend. This is combined with a low percentage of single authors. The pattern from the Journal of bacteriology is similar.

62 A Model

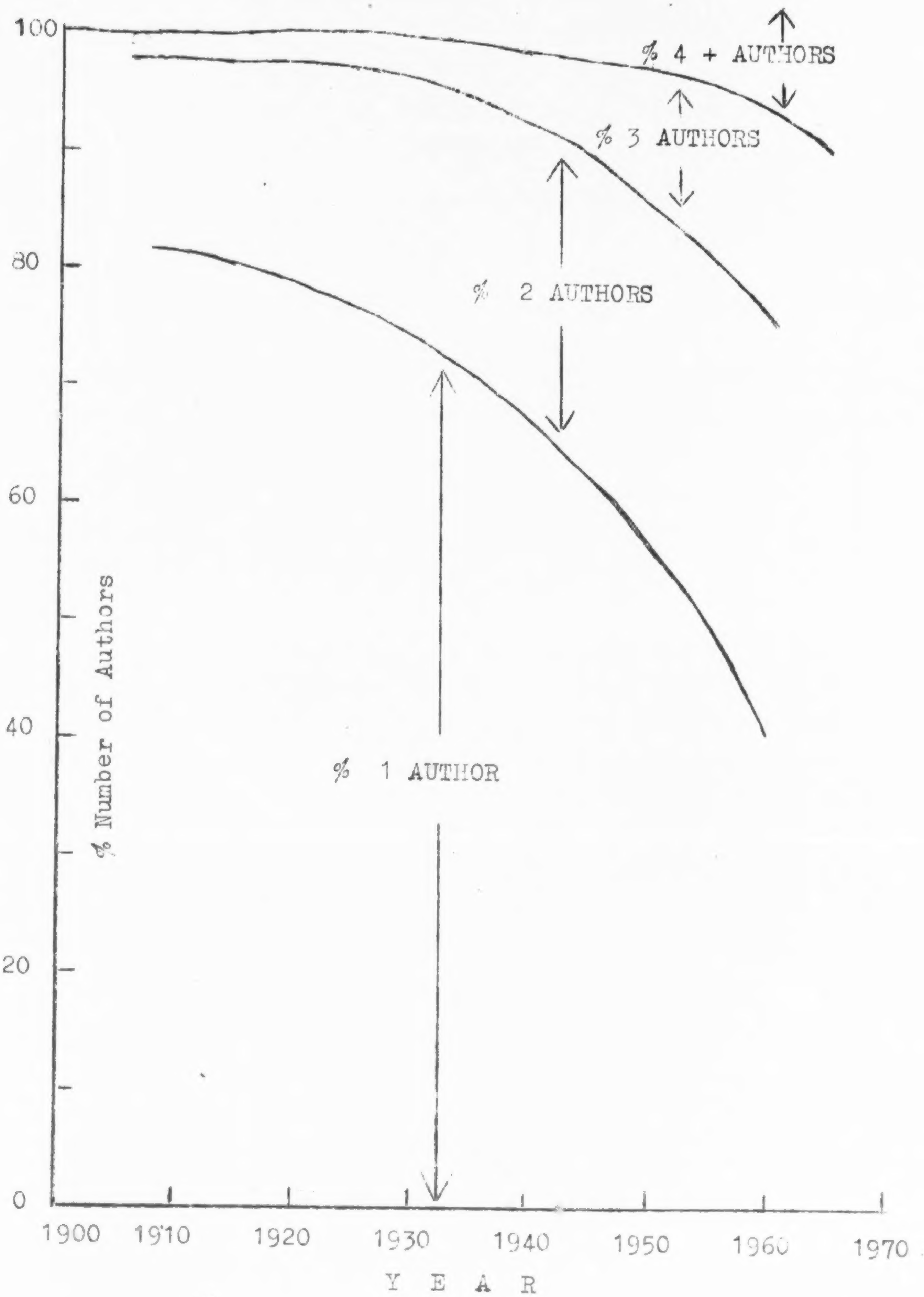
It is tempting to speculate that these three groups represent different phases of a logistic growth curve, or possibly steeped logistic curves, with ceiling conditions like those proposed for the growth of science and technology (7). (See Fig 9 in Sec 791). There appears to be a limit not only to the number of authors able to collaborate effectively, but that owing to human nature, there will always remain some proportion of single, double authors, etc. The figures for biomedical papers suggest that a curve followed by hunting fluctuations might be more appropriate.

This model could be used to explain the difference in the graphs by assuming that each subject has reached a different stage in its evolution as regards multiple authorship. The validity of such a model will have to be tested with new data, but assuming that it presents a true picture, it follows that if one of the limiting factors in multiple authorship is in some way subject-dependent, then the final proportions of single, joint, and multiple authors need not necessarily be the same for different sciences. On the other hand, if the limiting factors are common to science and scientists, the proportions could ultimately be the same for all sciences, though in both cases, the pattern of evolution need not necessarily be very similar.

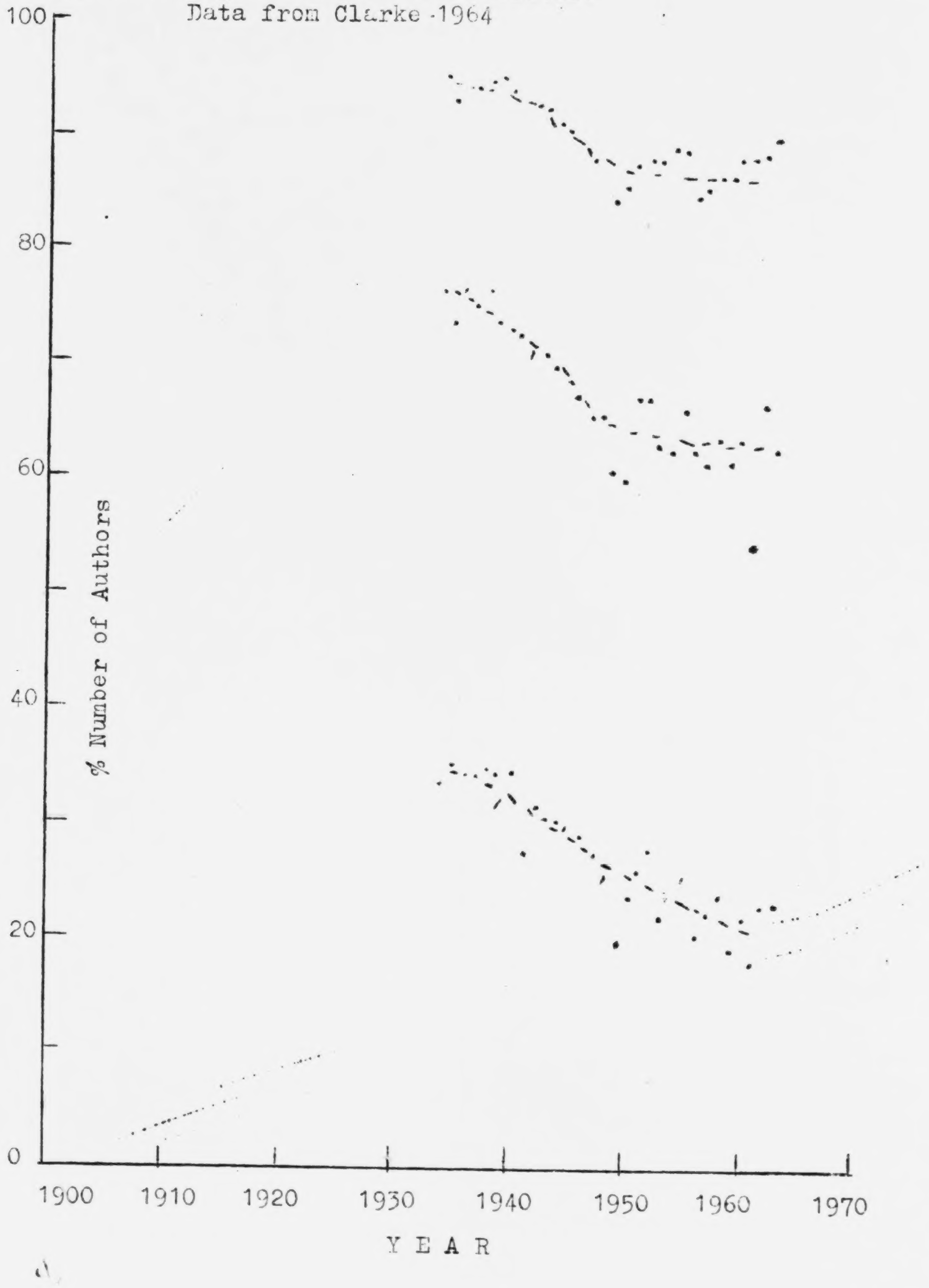
Work reported here indicates that finance, nature of research -- for example, theoretical, experimental, and observational -- are all factors which can affect collaboration and group research.

7 FIGURES

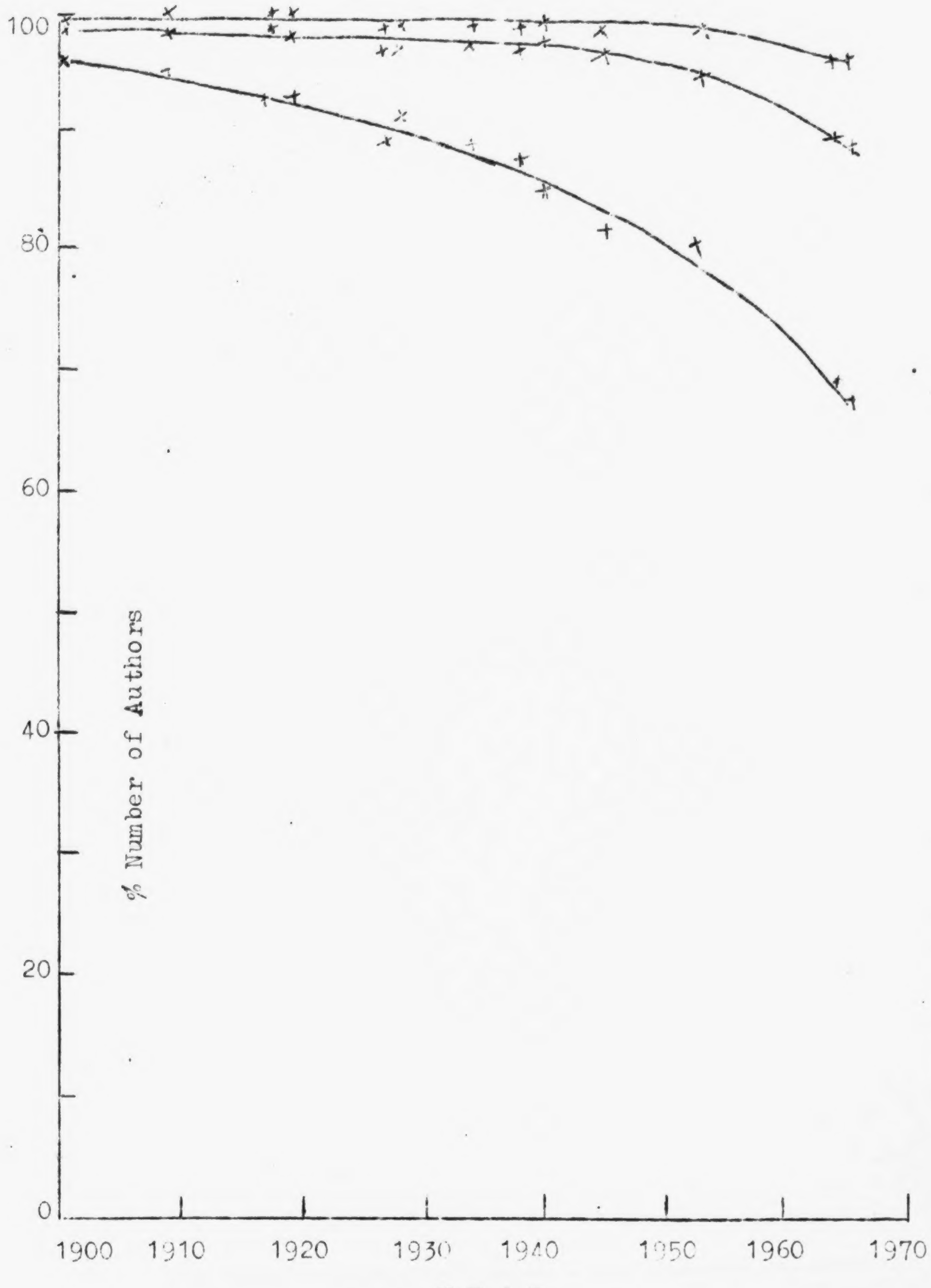
71 Fig 1. Chemical Abstracts (from Price 1963)



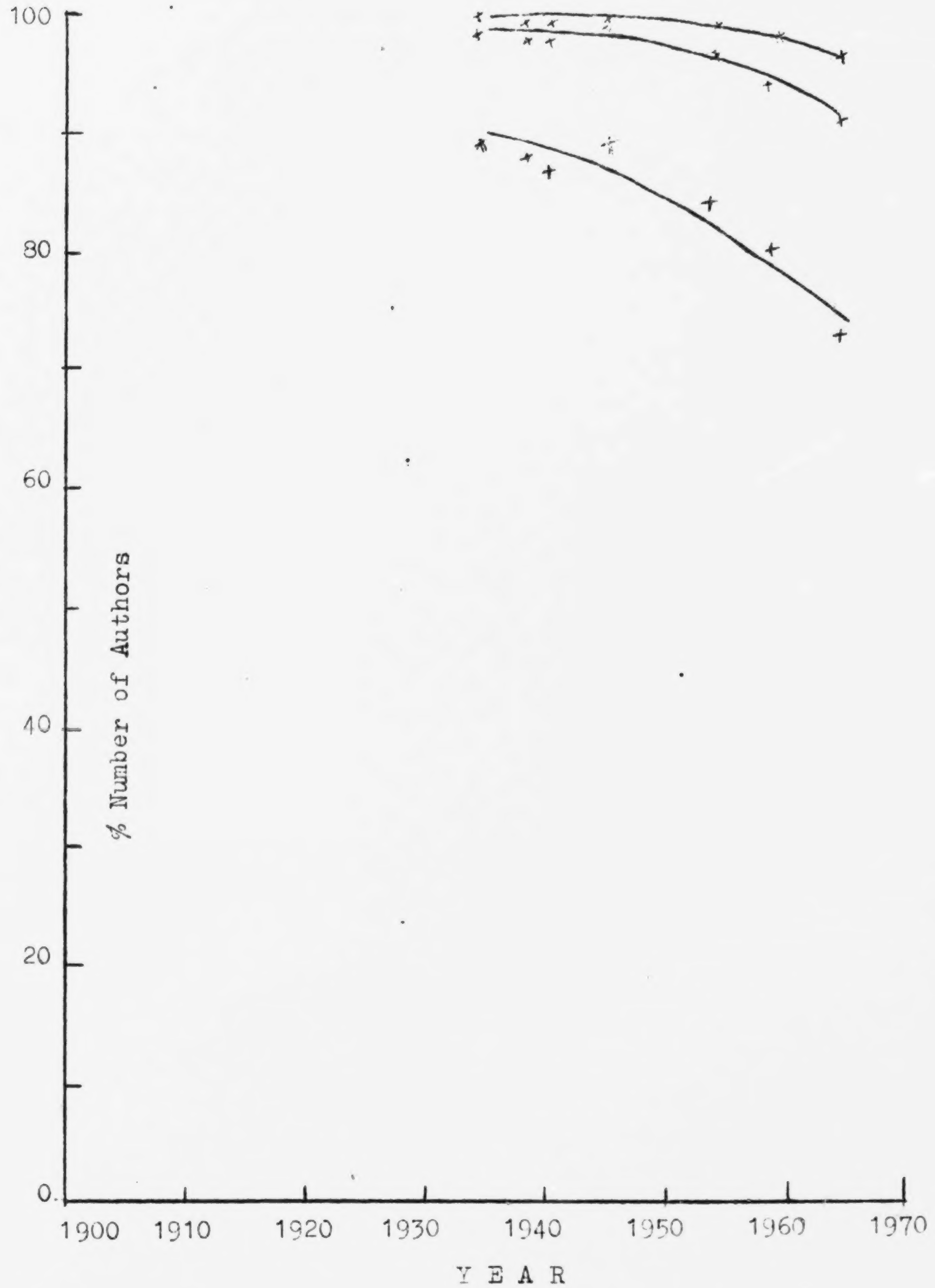
Sec 72. Fig 2. Biomedical Literature
Data from Clarke -1964



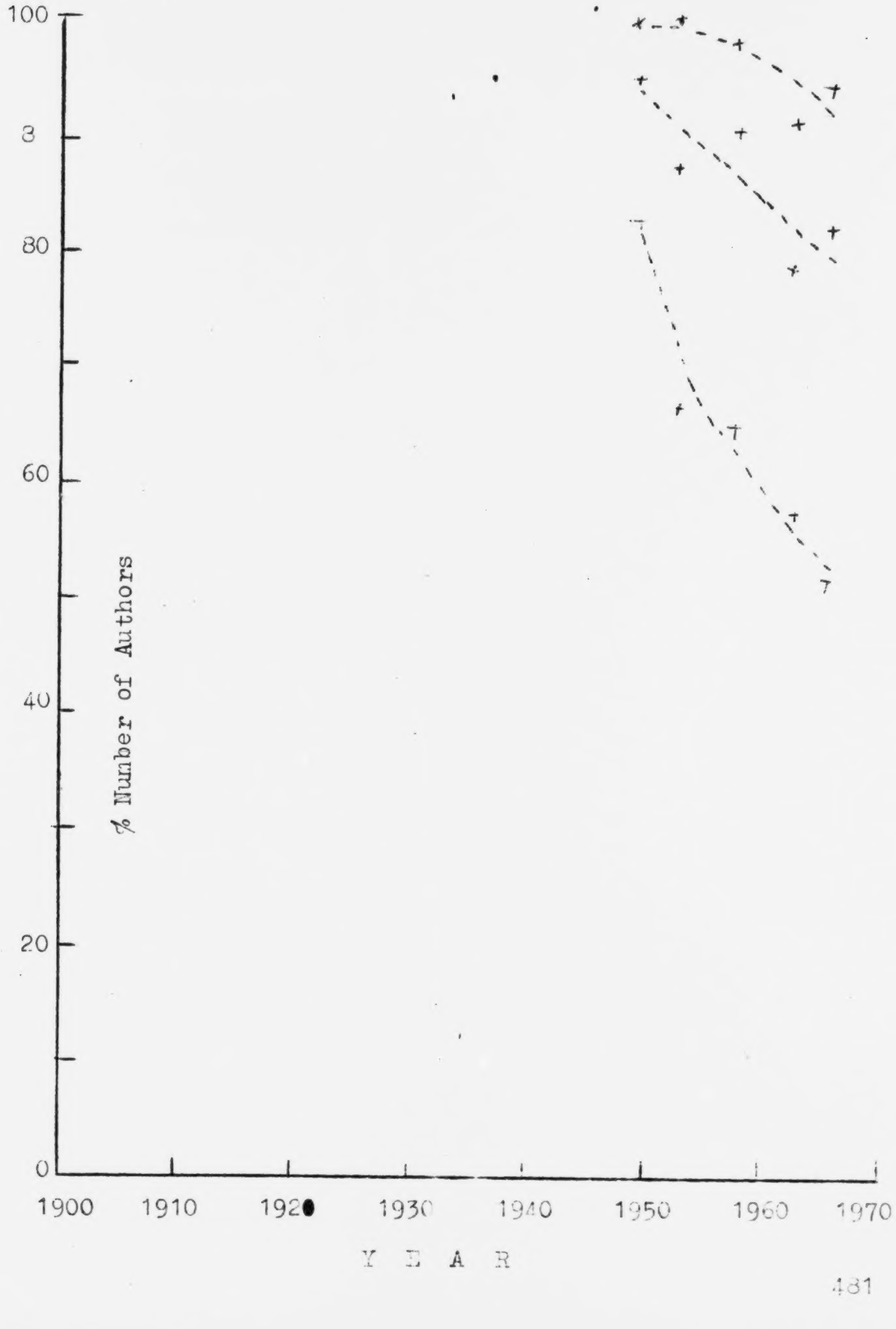
Sec 73. Fig 3. Astonomischer Jahresbericht



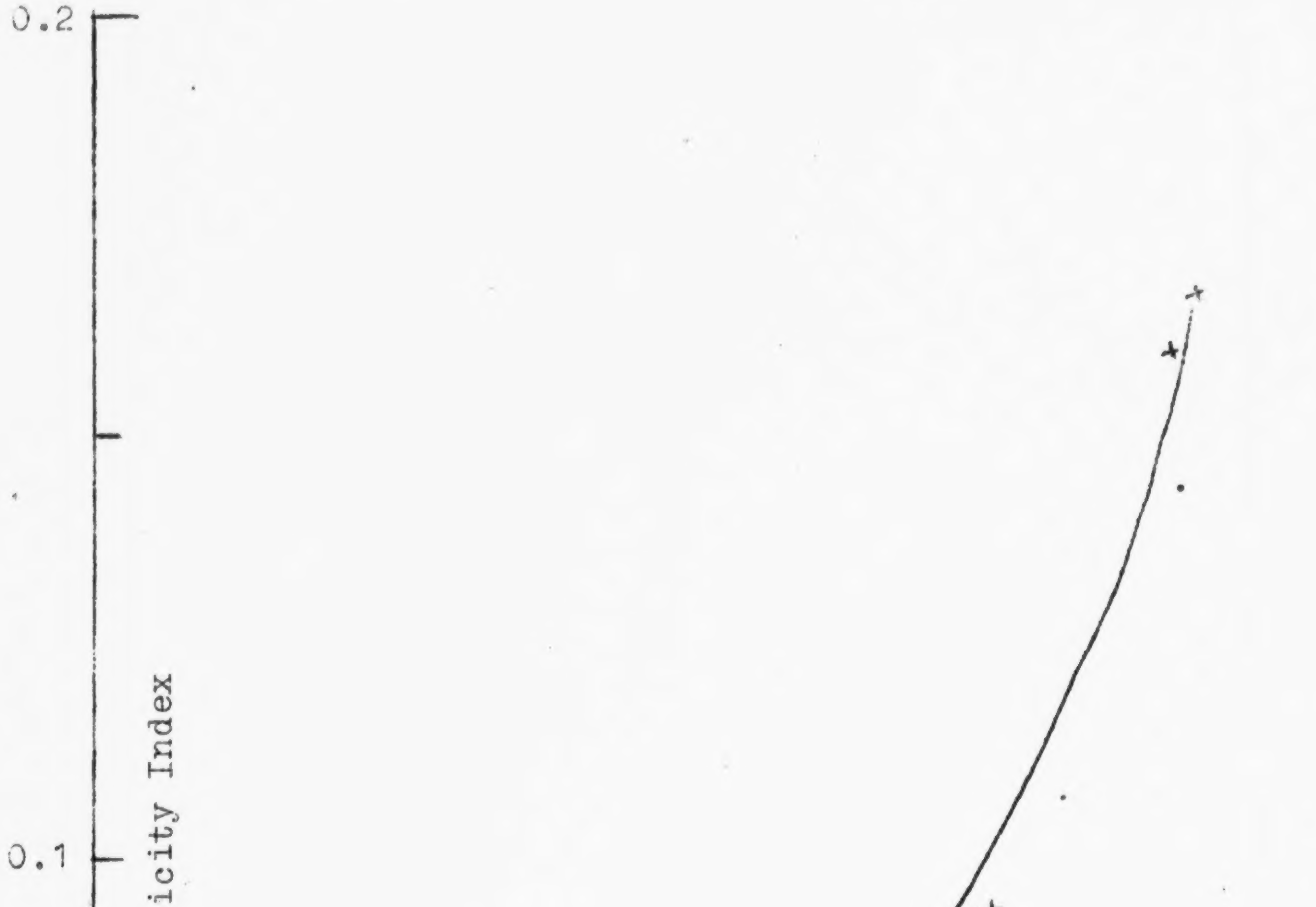
Sec 74. Fig 4. Bibliography and Index of Geology exclusive of North America



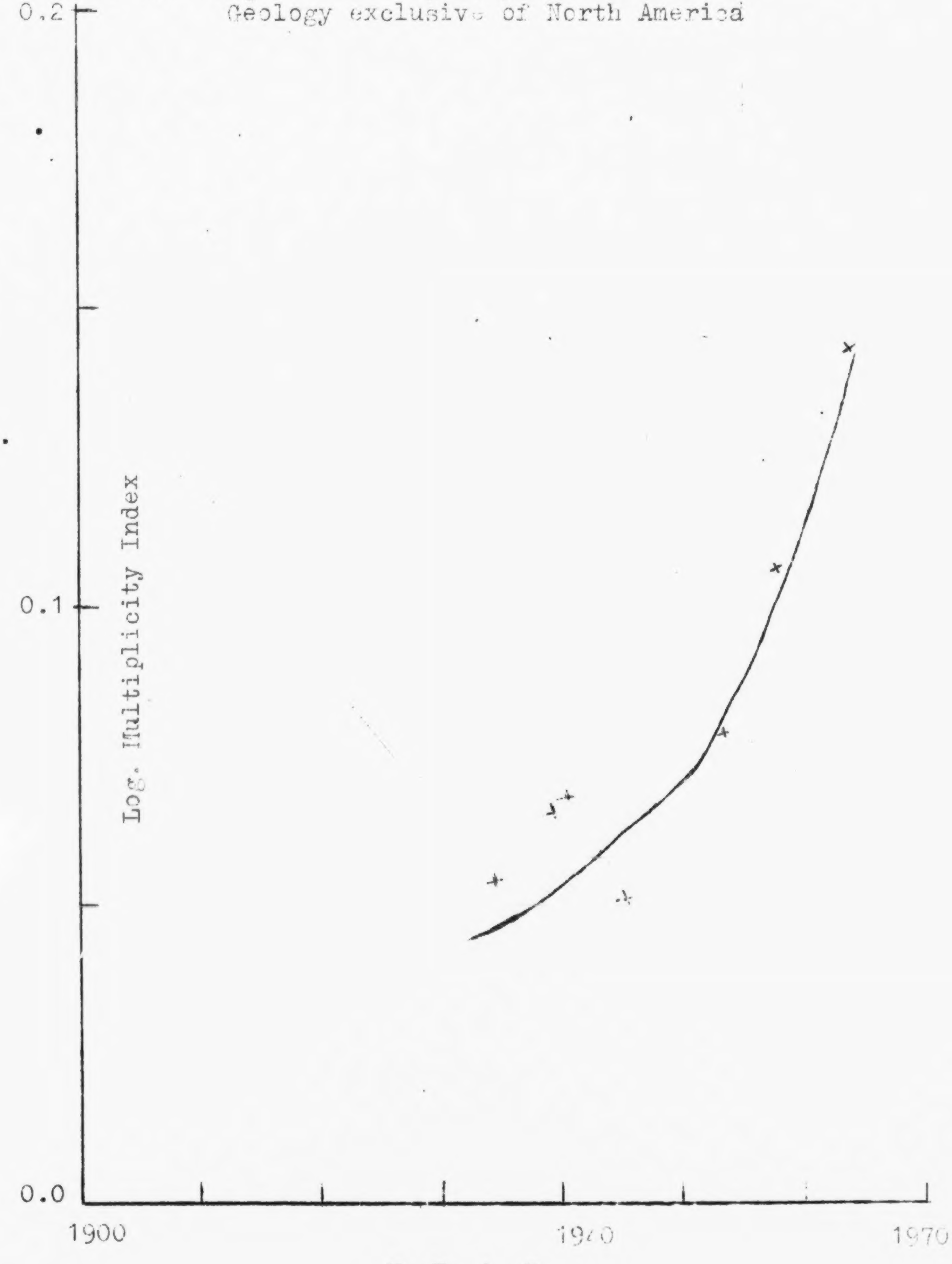
Sec 75. Fig 5. Radioastronomy Sections from Astronomischer Jahresbericht



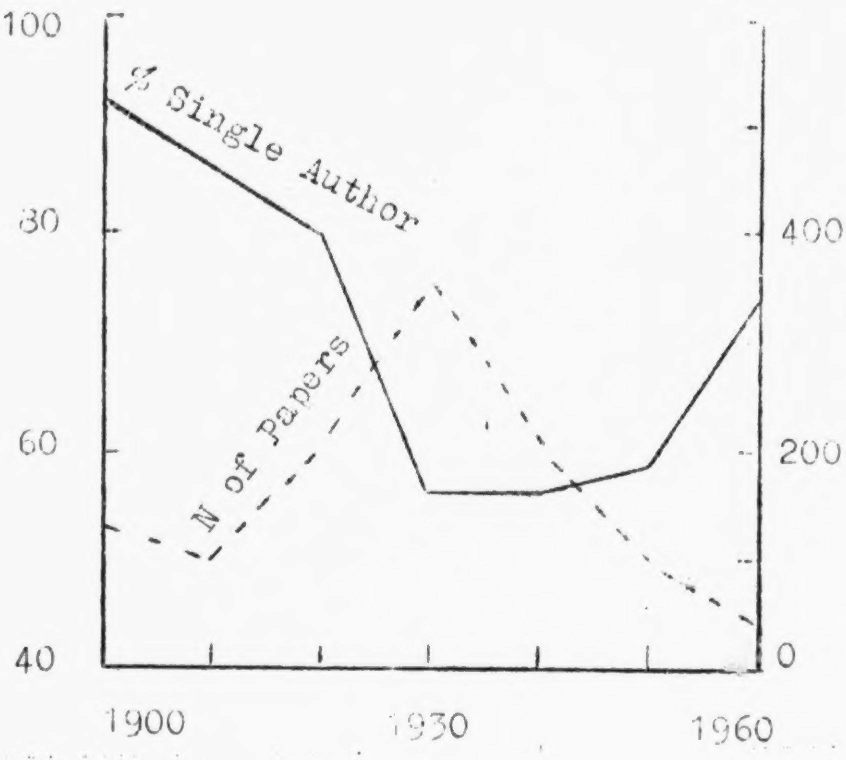
Sec 76. Fig 6. Astronomischer Jahresbericht



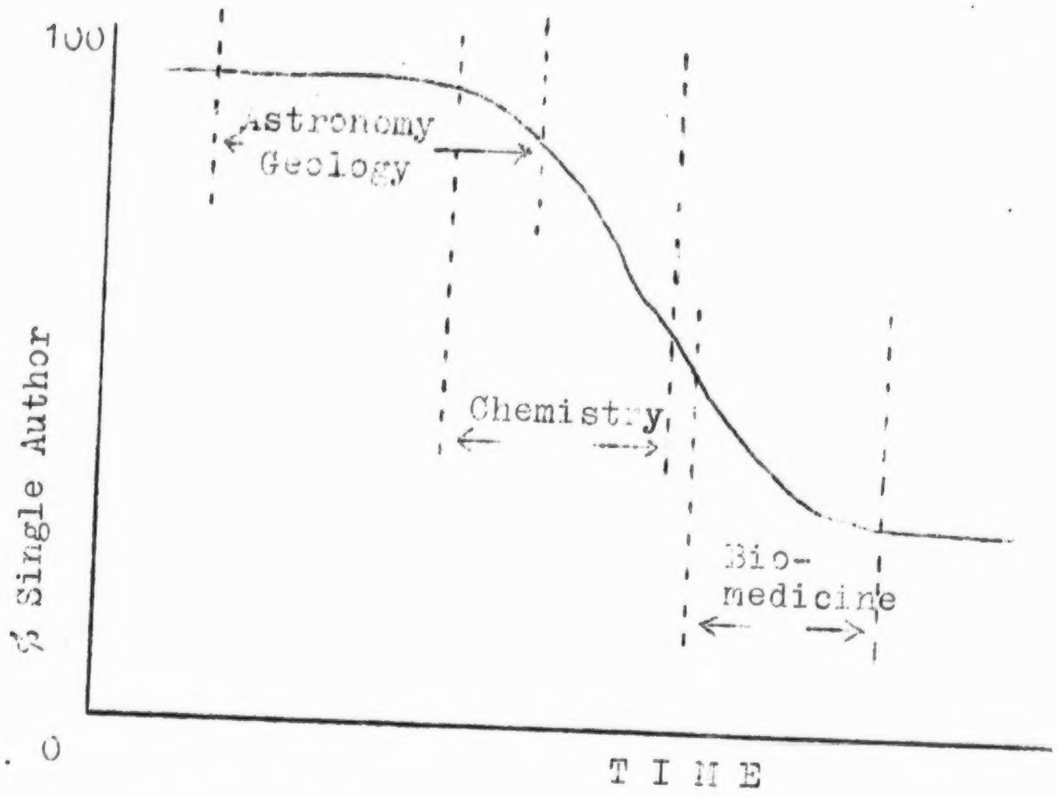
Sec 77. Fig 7. Bibliography and Index of Geology exclusive of North America



Sec 78. Fig 8. % Single Author Papers and Number of Papers in the Thermodynamics Section of *Physics abstracts*



Sec 791. Fig 9. Model



8 ACKNOWLEDGMENT

I would like to thank Dr A J Meadows for suggesting this project to me and for all his subsequent help and advice. I am also indebted to the Office for Scientific and Technical Information for financial support during the time this research was carried out.

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7 Sec 62 PRICE (D J de Solla). Little science, big science. 1963.

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CHARACTERISTICS OF DOCUMENTS CITED BY INDIAN PHYSICISTS: A CASE STUDY.

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The citations given in the Indian journal of pure and applied physics (5)(1967), were examined in order to develop a list of the most cited periodical publications, examine these periodical publications from the view-point of country of origin, subject-coverage, and age of the citations. Though a majority of documents cited were periodicals, the number of citations of non-periodical documents was not insignificant. The incidence of 'Self-citation' and 'Repeated citation' were also studied. The probable reasons for self-citation were examined. The incidence of Repeated Citation appears to be due to the following reasons: citing papers expound the same subject-field, at least one of the authors of the citing papers being common, atleast one of the authors of the citing papers working in one and the same institution, and cited more than once in the same paper.

0 INTRODUCTION

01 Criteria for Selection

The periodical publications are, by and large, the major source for retrospective search and also for current awareness purpose. In a recent study (3) it has been shown that "Looking at current issues of journals was by far the most popular method of obtaining current information" among UK

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and USA physicists. Thus, like any other discipline, the proper selection and the subsequent acquisition of periodical publications is of vital importance in the field of physics too. But, it is neither possible nor desirable for any library to acquire everything published in one speciality. 'Selectivity' is the answer to this problem. One favourable factor is that a good percentage of the articles on a specialised subject is published in a small number of periodicals -- the 'core periodicals'. Thus, in a specialised subject-field, a careful selection of periodicals can be made which will cover a good proportion of articles in that field. It has been found also that the use of periodicals in a given speciality, as well as in general, is concentrated on a small percentage of the total number of available periodical publications.

The objective criteria which have been found helpful for the selection and also weeding of periodical publications in any field are as follows:

1 Inclusion of the periodical publication in a secondary periodical publication -- indexing or abstracting periodical;

2 Demand of the clientele determined by analysing the circulation records of periodicals and by observing what the clientele actually read; and

3 Citation count in representative periodicals in the subject field.

The citation count or frequency of citation in representative periodicals is probably the most objective and useful of the three criteria. In this the titles of periodicals are ranked by the total number of citations they received.

02 Purpose of the Paper

The purpose of this paper is

1 Study the habits of Indian physicists in their approach to information gathering;

2 Develop a list of the periodical publications most frequently cited by the Indian physicists;

3 Examine these periodical publications from the viewpoint of country of origin, the subject-field covered, and the age of citation;

4 Place of non-periodical documents in the citations by Indian physicists;

5 Study of the Self-citation habit of the Indian physicists; and

6 Study of the Repeated Citation habit of the Indian physicists.

1 PROCEDURE

11 Selection of Source Periodical

The selection of source periodical for citation count did not present much difficulty. The choice of the Indian journal of pure and applied physics -- a monthly periodical published by the Council of Scientific and Industrial Research, India -- was guided by the following considerations:

1 It is the primary medium for the communication of the research results of Indian physicists;

2 Its purview encompasses the whole field of physics; and

3 Its complete coverage by the international abstracting periodicals.

In 1965, about 495 periodical publications were abstracted in the Physics abstracts. Out of these only 81 periodical publications were abstracted completely. The Indian journal of pure and applied physics was one of these. It accounted for 131 abstracts and had the Rank Order of 64 among the total number of periodical publications abstracted (1).

12 Selection of Citing Documents

As this is only a case study, the articles and short-communications in the Indian journal of pure and applied physics (5) (1967) were selected for the purpose of this study.

13 Preparation of Entry for Citing Document

For each citing document -- article and short-communication, -- an entry was prepared on a standard cataloguing slip. In each entry, the name of the author(s), title of the document, and the bibliographical specifications of the source periodical -- the Indian journal of pure and applied physics, were noted. In case of the citing document being a short-communication, the symbol (SC) was also noted to distinguish it from articles. Other details noted in the entry were as follows:

1 Serial Number, beginning with 1;
2 Total Number of citations;
3 Number of author(s) for the citing document;
4 Number of pages;
5 Address(es) of the author(s);

6 Date of receipt of manuscript and/or revised manuscript;

7 Time lag in publication;

8 Name of the institution or agency providing financial assistance in the form of scholarship or funds; and

9 Class Number with feature heading.

14 Preparation of Entry for Cited Document

For each cited document or citation, an entry was prepared on a standard cataloguing slip. In each entry the name of the author(s), title of the cited document -- if available, -- and the bibliographical specifications of the host document as given in the citing document, were noted. In addition, the following items of informations were also noted in the entry:

1 The symbol (SC) to denote that the citing document is a short communication;

2 Reference Number of the cited document, consisting of the serial number of the citing document, a colon, and the Serial Number of the cited document among the total number of cited documents as given in the Reference Section of the citing document, beginning with 1. In a few cases, one serial number in the Reference Section contained multiple citations. In such cases each individual citation it contained was counted separately;

3 Nature of the cited document -- that is, whether a book, technical report, data publication, conference paper, patent, standard, thesis, periodical article, etc; and

4 Information about self-citation.

2 INDIAN JOURNAL OF PURE AND APPLIED PHYSICS

21 Contributions

The contributions consist of original articles and short communications. The total number of contributions in the Indian journal of pure and applied physics (5)(1967) was 224 -- 148 articles and 76 short communication. The subject-wise breakdown of contributions is given in Table 1.

211 Table 1. Subject-wise Distribution of Contributions

SN	Subject	Number of contributions		Total
		Articles	Short-Communications	
1	Ic Measuring Instruments. Metrology	-	1	1
2	B3 Analysis, Calculus. Functions	3	-	3
3	B7 Mechanics	2	-	2
4	B7,5 Fluid Mechanics. Hydrodynamics	5	6	11
5	B7,5:c7 Magnetohydrodynamics	1	-	1
6	B7,8 Aeromechanics. Gas Mechanics	2	-	2
7	BUZ Astronomy and Astrophysics	3	-	3
8	C2,1 Solid State Physics	19	9	28
9	C2,1;c Physical Properties of Solids	9	5	14

SN	Subjects	Number of contributions		Total
		Articles	Short-Communications	
10	C2,86 Plasma Physics	1	-	1
11	C3 Sound. Acoustics	5	-	5
12	C4 Heat. Thermodynamics	4	3	7
13	C5 Optics. Light	7	1	8
14	C5;3 Spectroscopy	20	12	32
15	C6 Electricity	1	-	1
16	C6;25 Electric Discharge. Radiation. Ionization	2	1	3
17	C6,1Z Electric current and Electrostatics	6	4	10
18	C7 Magnetism. Electromagnetism	1	-	1
19	C9B Microphysics	4	4	8
20	C9BOZ Atomic and Molecular Physics	4	1	5
21	C9B1 Molecular Physics	5	10	15
22	C9B3 Nuclear Physics	7	1	8
23	C9B8 Elementary Particles	3	2	5
24	CM96 Radioactivity	3	1	4
25	D2 Building Engineering	1	-	1
26	D6,5 Electronics	7	3	10
27	D6,6 Electrical Engineering	5	-	5
28	D7,4 Telecommunication	1	-	1
29	D8,(C5) Optical Instruments	2	1	3
30	E Chemistry	1	3	4
31	H1;8 Crystallography	11	5	16
32	HUC Geophysics	1	1	2
33	HUC7 Meteorology	2	1	3
34	M95 Photography and Cinematography	1	1	1
	Total	148	76	224

22 Author Productivity

These 224 contributions came from a total of 293 different authors. Table 2 shows the number of contribution(s) against each author for which he was one of those responsible. Table 3 shows the number of joint authors and the number of contributions.

221 Table 2. Number of Author and Number of Contributions

SN	Number of Author	Number of contribution
1	232	1
2	32	2
3	18	3
4	4	4
5	3	5
6	1	7
7	3	8

222 Table 3. Joint Authors and Contributions

SN	Number of Authors	N of contributions		Total
		Articles	Short communications	
1	1	49	33	82
2	2	75	28	103
3	3	18	12	30
4	4	6	3	9

23 Time-lag in Publication

A varying range of time-lag in publication of a contribution from its first submission and its appearance in the Indian journal of pure and applied physics (5)(1967) was observed. It may be largely due to the delay at the referencing end or at the printing end. Table 4 shows the range of time lag in publication of the contributions.

231 Table 4. Time lag and Contributions

SN	Time Lag in months	Number of contributions		
		Articles	Short Communication	Total
1	3	–	3	3
2	4	2	4	6
3	5	7	5	12
4	6	6	12	18
5	7	11	12	23
6	8	4	15	19
7	9	5	11	16
8	10	9	6	15
9	11	8	3	11
10	12	11	1	12
11	13	13	3	16
12	14	18	–	18
13	15	15	–	15
14	16	26	1	27
15	17	8	–	8
16	18	3	–	3
17	19	1	–	1
18	20	1	–	1

232 Annotation

1 In a few cases, the date of receipt of revised manuscript alone was available, which has been taken for calculating the time lag in publication;

2 The median time lag for articles is 13 months, for short communications 6 months, and for contributions as a whole 10 months; and

3 The average time lag for articles is 11.7 months, for short communications 7.7 months, and for contributions as a whole 10.4 months.

24 Time Lag and Revised Manuscript

Out of the total of 224 contributions, the authors of 71 contributions, -- 54 articles and 17 short communications, -- or 31.7 percent of the total contributions, submitted revised manuscripts. The time lag in publication of the revised manuscripts is shown in Table 5.

241 Table 5. Time Lag and Revised Manuscript

SN	Time Lag in months	Number of contributions		
		Articles	Short communication	Total
1	3	1	1	2
2	4	1	3	4
3	5	2	1	3
4	6	1	6	7
5	7	3	3	6
6	8	2	2	4
7	9	4	1	5
8	10	7	-	7
9	11	5	-	5
10	12	10	-	10
11	13	6	-	6
12	14	8	-	8
13	15	2	-	2
14	16	2	-	2

242 Annotation

1 The median time lag for articles is 12 months, for short communications 6 months, and for contributions as a whole 10 months; and

2 The average time lag for articles is 11 months, for short communications 6 months, and for contributions as a whole 9.8 months.

25 Nature of Institution and Number of Contributions

Table 6 gives a general distribution of the contributions according to the nature of institution where the research was carried out.

251 Table 6. Place of Origin of Contributions

SN	Nature of Institution	Number of contributions		
		Article	Short communication	Total
1	University, including other educational institutions	120	64	184
2	C S I R, India	27	7	34
3	Defence Laboratories	4	-	4
4	Industrial and other Laboratories	2	5	7
5	Foreign	4	2	=6

26 Financing the Research

As many as 12 institutions and organisations, both Indian and foreign, financed the various research projects, in the form of scholarships or funds, the results of which have been published in the Indian journal of pure and applied physics (5)(1967). This was determined by going through the acknowledgement section of each of the contributions. Table 7 gives a list of the financing bodies in a ranked sequence.

261 Table 7. List of Financing Bodies

SN	Name of the Financing body	Number of contributions		
		Article	Short communication	Total
1	CSIR, India	39	11	50
2	Ministry of Education, India	6	-	6
3	U G C, India	2	4	6
4	Department of Atomic Energy, Government of India	3	1	4
5	Government of India	2	1	3
6	National Bureau of Standards, USA	2	1	3
7	Ministry of Scientific and Cultural Affairs, India	1	-	1
8	Nadia Education Society, Gujarat	-	1	1
9	R & D Organisation, Ministry of Defence, India	1	-	1
10	State Industrial Research Committee, Government of Gujarat	1	-	1
11	Advance Research Projects Agency, USA	1	-	1
12	Rutherford Laboratory, UK	1	-	1
	Total	59	19	78

3 CHARACTERISTICS OF CITATIONS IN INDIAN JOURNAL OF PURE AND APPLIED PHYSICS

31 Number of Citations

The total number of citations in the
224 articles published in the twelve

monthly issues of the *Indian journal of pure and applied physics* (5)(1967) was 1972. This amounted to 3.2 citations per page, or 320 citations for 100 pages. Table 8 gives the distribution of citations.

311 Table 9. Distribution of Citations

SN	Number of citations	Number of contributions		
		Article	Short Communication	Total
1	0	2	4	6
2	1	4	4	8
3	2	6	10	16
4	3	7	10	17
5	4	7	6	13
6	5	14	5	19
7	6	7	8	15
8	7	7	4	11
9	8	13	7	20
10	9	9	1	10
11	10	15	4	19
12	11	6	4	10
13	12	5	5	10
14	13	7	1	8
15	14	7	2	9
16	15	5	1	6
17	16	3	-	3
18	17	5	-	5
19	18	3	-	3
20	19	3	-	3
21	20	2	-	2
22	21	3	-	3
23	22	2	-	2
24	23	2	-	2
25	25	1	-	1
26	27	1	-	1
27	28	1	-	1

312 Annotation

1 The median number of citations for articles is 9, for short communications 5, and for contributions

as a whole 8.

2 The average number of citations for articles is 10.3, for short communications 5.8, and for contributions as a whole 8.8.

3 These 1972 citations consisted of 1616 citations to periodical documents and 350 citations to non-periodical documents.

32 Citation to Non-Periodical Document

Out of the total number of 1972 citations, the number of citations to non-periodical documents was 356 - 275 citations in articles and 81 citations in short communications. Table 9 gives the distribution of citations to non-periodical documents.

321 Table 9. Categories of Non-periodical citation

SN	Category	Number of citations in		
		Article	Short communication	Total
1	Book	179	57	236
2	Technical report	22	6	28
3	Data publication (Table, Data, Etc)	15	5	20
4	Commission proceeding	1	-	1
6	Thesis	22	4	26
7	Standard	2	-	2
8	Index card (NB)	2	-	2
		275	81	356

Citations to non-periodical documents is excluded from any further analysis. However, it is interesting to note thatabout 18% of the citations are to non-periodical documents.

4 CHARACTERISTICS OF CITATIONS TO PERIODICAL DOCUMENTS

41 Periodical-wise Distribution of Citation

A list of periodicals ranked according to the frequency of citations, out of the 1616 citations to periodical documents analysed, is shown in Table 10. Only the names of those items that were cited five or more times, are given in the list. In all, 255 publications contributed these 1616 citations.

411 Table 10. Rank of Periodicals by Frequency of Citation

Rank	Periodical	N of citations	Cumul Total
1	Physical review	178	178
2	Journal of chemical physics	108	286
3	Indian journal of pure and applied physics	64	350
4	Journal of applied physics	60	410
5	Indian journal of physics	48	458
6	Proceedings of the Royal Society. London -- Series A Mathematical and Physical Sciences	45	503
7	Proceedings of the Physical Society. London	37	540
8	Journal of the Physical Society of Japan	31	571
	Journal of Physics and Chemistry of Solids	31	602

Rank	Periodical	N of citations	Cumul Total
	Acta crystallographica	31	633
9	Journal of the American Chemical Society	30	663
10	Transactions of the Faraday Society	29	692
11	Nuovo cimento	25	717
	Philosophical magazine	25	742
12	Proceedings of the Indian Academy of Sciences, Section A Physical sciences	24	766
13	Journal of the Chemical Society	23	789
14	Zeitschrift fuer physik	22	811
15	Reviews of modern physics	20	831
16	Journal of scientific and industrial research, Section B Physical sciences	19	850
17	Zeitschrift fuer naturforschung. Ausgab A Astrophysik, physik und physikalischer chemie	18	868
18	Spectrochimica acta	17	885
19	Nuclear physics	16	901
	Proceedings of the IEEE	16	917
	Review of scientific instruments	16	933
20	Canadian journal of physics	15	948
	Zeitschrift fuer physikalische chemie. Leipzig	15	969
21	Journal of geophysical research	14	977
	Nature, London	14	991
22	Journal of the Acoustical Society of America	13	1004

Rank	Periodical	N of citations	Cumul Total
22	Journal of physical chemistry	13	1017
	Physical review letters	13	1030
	Soviet physics - Solid state	13	1043
23	Proceedings of the National Institute of Sciences of India, Sec A Physical Sciences	12	1055
24	Astrophysical journal	11	1066
	Physica	11	1077
	Soviet Physics - Crystallography	11	1088
25	Philosophical transactions of the Royal Society, London - Series A Mathematical and Physical Sciences	10	1098
	Progress of theoretical Physics. Japan	10	1108
26	Journal of the Optical Society of America	9	1117
27	Arkiv for fysik	8	1125
	Journal of the Franklin Institute	8	1133
	Nuclear instruments and methods	8	1141
	Physics letters	8	1149
	Scientific reports, Tohoku University	8	1157
28	Current science	7	1164
	Journal of atmospheric and terrestrial physics	7	1171
	Journal of science and engineering research	7	1178
	Solid state electronics	7	1185
	Zeitschrift fuer angewante mathematik und mechanik	7	1192

Rank	Periodical	N of citations	Cumul Total
28	Zeitschrift fuer electrochemie	7	1199
29	British journal of applied physics	6	1205
	Helvetica physica acta	6	1211
	Journal of molecular spectroscopy	6	1217
	Proceedings of the Institution of Electrical Engineers	6	1223
30	Acta metallurgica	5	1228
	Annalen der physik, Leipzig	5	1233
	Annals of physics	5	1238
	Comptes rendus hebdomadaires de seances de l' Academie des Sciences, Paris	5	1243
	Journal of the American Ceramic Society	5	1248
	Journal de physique et la radium. Paris	5	1253
	Journal of research of the National Bureau of standards - Sec A Physics and chemistry	5	1258
	Physics of fluids	5	1263
	Physikalische zeitschrift	5	1268
	Transactions of the American Society of Mechanical Engineers	5	1273
	Zeitschrift fuer kristallographie, kristallogeometrie, kristallophysik, kristallochemie, Leipzig	5	1278
	Journal of experimental and theoretical physics (English translation of Zhurnal experimentalnoi i teoreticheskoi fiziki)	5	1283
	Applied scientific research - Sec A Mechanics, Heat, Chemical engineering, Mathematical methods	5	1293

Rank	Periodical	N of citations	Cumul Total
30	Quarterly journal of applied mathematics	5	1298
31	(11 titles)	4 each	1342
32	(29 titles)	3 each	1429
33	(38 titles)	2 each	1505
34	(111 titles)	1 each	1616

412 Annotation

1 Twenty-five per cent of the periodical citations was to 4 periodicals;

2 Fifty per cent of the periodical citations was to 17 periodicals;

3 Seventy-five per cent of the periodical citations was to 53 periodicals;

4 Ninety per cent of the periodical citations was to 123 periodicals; and

5 An additional 132 periodicals publications contributed the last 10% of the periodical citations.

42 Country of Origin of Cited Periodical

The 1616 citations to periodical documents were contributed by 255 periodical publications published from 20 countries. Although a number of periodical publications publish contributions outside the country of publication, no attempt was made to ascertain the nationality of the author or the country where the research work was carried out, as one of the purposes of the paper is to find out the periodicals most cited by Indian physicists. Table 11 gives the names of countries ranked according to number of cited periodicals.

421 Table 11. Countries Ranked by Number of Periodical Publications

Rank	Country	Periodical		Citation	
		Number	Cumul total	Number	Cumul total
1	United States	85	85	680	680
2	United Kingdom	41	126	278	958
3	India	33	159	228	1186
4	Germany	25	184	116	1302
5	Japan	12	196	63	1365
	France	12	208	25	1390
6	U S S R	9	217	40	1430
7	Netherlands	8	225	52	1482
8	Canada	4	229	24	1506
	Czechoslovakia	4	233	4	1510
9	Denmark	3	236	36	1546
	Sweden	3	239	12	1558
	Australia	3	242	9	1567
	Rumania	3	245	5	1572
10	Italy	2	247	26	1598
	Switzerland	2	249	9	1607
	Austria	2	251	4	1611
	Hungary	2	253	3	1614
11	Poland	1	254	1	1615
	South Africa	1	255	1	1616

422 Annotation

1 Indian physicists cited largely the periodical publications published in English-speaking

countries, and in English language.

2 The citation of Russian periodical publications seems to be due to their availability in cover-to-cover English translations.

3 India has a Rank position of 3 both by virtue of the number of periodical publication as well as the number of periodical citations.

43 Frequency of Citations by Year of Publication

In order to find out the interest of Indian Physicists in older documents, the citations were arranged by the year of publication of the host periodicals. Table 12 gives the number of citations according to the year of publication of the host periodical.

431 Table 12. Number of Citations and Year of Publication

Year of publication	N of citations	Cumulative total	Year of publication	N of citations	Cumulative total
1808	1	1	1915	1	15
1882	1	2	1917	2	17
1886	1	3	1920	1	18
1892	1	4	1921	2	20
1899	1	5	1923	3	23
1904	1	6	1925	2	25
1905	1	7	1926	1	26
1907	1	8	1927	3	29
1908	1	9	1928	8	37
1910	1	10	1929	9	46
1911	2	12	1930	4	50
1913	2	14	1931	10	60

Year of publication	N of citations	Cumulative total	Year of publication	N of citations	Cumulative total
1932	4	64	1950	47	356
1933	7	71	1951	37	393
1934	14	85	1952	52	445
1935	15	100	1953	49	494
1936	22	122	1954	51	545
1937	17	139	1955	47	592
1938	12	151	1956	57	649
1939	12	163	1957	82	731
1940	17	180	1958	61	792
1941	14	194	1959	70	862
1942	5	199	1960	84	946
1943	8	207	1961	99	1045
1944	11	218	1962	112	1157
1945	11	229	1963	136	1293
1946	20	249	1964	116	1409
1947	14	263	1965	113	1589
1948	22	285	1967	27	1616
1949	24	309			

432 Annotation.

1 The oldest citation was of the year 1808;

2 Only 5 citations were of the nineteenth century;

3 Only 18 citations were of the first quarter of the present century;

4 Only 296 citations were of the first half of the present century; and

5 The rest of the 1297 citations were for the period 1950 to 1967.

44 Age of Citations

Table 13 shows the distribution of citations by age. The calculation of the age of the citations was done on the following basis:

1 The year of publication of citation -- that is the year of publication of the host periodical was subtracted from that of the citing papers -- that is the year of publication of the source periodical the Indian journal of pure and applied physics (5)(1967);

2 The month of publication of the citing paper was not taken into consideration; and

3 The date of receipt of manuscript or revised manuscript of the citing paper was not taken into consideration, rather, as mentioned above, the year of publication '1967' was taken into consideration for the purpose of calculation.

441 Table 13. Distribution of Citations by Age

Age in Years	N of Citations	Cumulative Total
0	27	27
1	67	94
2	113	207
3	116	323
4	136	459
5	112	571
6	99	670
7	84	754
8	70	824
9	61	885
10	82	967
11-20	400	1367
21-30	127	1494
31-40	96	1590
41+	26	1616

442 Annotation

1 About 25% of the citations was less than 4 years old at the time of citation;

2 About 50% of the citations was less than 8 years old at the time of citation; and

3 About 75% of the citations was less than 15 years old at the time of citation.

45 Subject-wise Distribution of Host Periodicals

Table 14 shows the subject-wise breakdown of host periodical publications, in which one or more citations were published. The largest number of periodicals was in physics, 68 periodical publications with 752 citations. The second largest group of host periodicals was in Engineering, 49 periodicals with 127 citations. The third position was for Natural Sciences, 30 periodicals with 120 citations. And the fourth position was for Chemistry, 27 Periodicals with 278 citations.

451 Table 14. Subject-wise Distribution of Cited Periodicals

Subject of periodical		N of periodicals	N of citations
a	Generalia bibliography	1	1
A	Natural Sciences	30	120
AJ	Soil Sciences	2	2
AZ	Mathematical Sciences	11	88
B	Mathematics	13	30
B7	Mechanics	5	8
BV	Astronomy	7	13

Subject of periodical.		N of periodicals	N of citations
BX	Astrophysics	4	17
BZ	Physical Sciences	7	72
C	Physics	68	752
D	Engineering	49	129
DZ	Chemical Sciences	1	2
E	Chemistry	27	278
F	Technology	8	18
H1;8	Crystallography	3	46
HUC	Geophysics	11	34
HX	Mining	3	3
J	Agriculture	2	2
KX	Animal Husbandry	1	1
L	Medicine	1	1
T	Education	1	1
		Total 255	1616

5 CHARACTERISTICS OF SELF-CITATION

51 Incidence of Self-Citation

The incidence of the phenomenon of self-citation or citing of one or more earlier contributions of the one or more of the authors of the citing paper was found to be fairly widespread. Table 15 shows self-citations in the Indian journal of pure and applied physics (5),(1967).

511 Table 15. Distribution of Self-Citations

N of citations	Article								Short Communication			
	N of Self-citations								N of Self-citations			
	1	2	3	4	5	6	7	8	1	2	3	4
2	2	-	-	-	-	-	-	-	2	1	-	-
3	2	1	-	-	-	-	-	-	1	-	-	-
4	-	-	1	-	-	-	-	-	2	-	-	-
5	4	1	2	-	-	-	-	-	3	1	-	-
6	2	3	1	-	-	-	-	-	2	-	1	-
7	1	1	1	-	-	-	-	-	2	-	1	-
8	5	-	-	1	-	-	-	-	2	2	-	-
9	3	-	-	1	2	-	-	-	-	-	-	-
10	1	1	-	1	-	1	-	-	-	-	-	-
11	1	-	1	-	-	-	-	-	1	-	-	-
12	2	1	-	-	1	-	-	-	2	-	-	1
13	2	1	-	-	1	2	-	-	-	-	1	-
14	2	-	3	-	-	-	-	-	2	-	-	-
15	1	-	1	-	-	-	-	-	-	-	-	-
16	-	-	-	-	1	-	-	-	-	-	-	-
17	-	1	-	-	-	-	2	-	-	-	-	-
18	-	1	1	1	-	-	-	-	-	-	-	-
19	1	1	-	-	-	-	-	-	-	-	-	-
20	2	-	-	-	-	-	-	-	-	-	-	-
21	-	-	1	-	-	-	2	-	-	-	-	-
22	-	1	-	-	-	-	-	-	-	-	-	-
23	1	1	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	1	-	-	-	-	-	-	-	-
26	-	-	1	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	-	1	-	-	-	-
Total	32	17	13	5	5	3	4	1	19	4	2	1

512 Annotation

1 Altogether, 103 papers -- 77 articles and 26 short communications -- carried self-citations.

2 About 45.9 % of the papers -- 52.0% articles and 34.2% short communications-- carried self-citations, ranging from 1 to 8 in number.

3 The distribution of self-citations was as follows:

Self-citation	Article	Short communication	Total
1	32	19	51
2	14	4	18
3	13	2	15
4	5	1	6
5	5	-	5
6	3	-	3
7	4	-	4
8	1	-	1
Total	77	26	103

52 Number of Authors and Self-citations

Table 16 shows the number of self-citations for the number of author(s) of citing paper against the ratio between the number of author(s) common for the citing paper and the cited document, and the number of authors of the cited document.

521 Table 16. Number of Self-citations

N of common authors	Articles					Short communications				
	N of authors of citing paper					N of authors of citing paper				
N of authors of cited paper	1	2	3	4	Total N of Self-citations	1	2	3	4	Total N of Self-citations
1/1	22	23	8	-	53	9	4	-	-	13
1/2	13	40	10	-	63	1	8	-	-	9
2/2	-	40	4	-	44	-	6	-	-	7
1/3	6	17	2	-	25	1	2	1	-	4
2/3	-	3	3	-	6	-	2	-	-	2
3/3	-	-	5	-	5	-	-	-	-	-
1/4	-	-	-	-	-	-	-	-	-	-
2/4	-	-	-	1	1	-	-	-	-	-
3/4	-	-	-	2	2	-	-	-	-	-
4/4	-	-	-	-	-	-	-	-	2	2
1/5	-	-	-	-	-	1	-	-	-	1

522 Annotation

1 The total number of self-citations was 237 -- 223 to periodical documents and 14 to non-periodical documents.

2 The self-citations to periodical documents amounted to 187 out of 199 in the case of articles, and 36 out of 38 in the case of short communications.

3 In case of nearly 51 percent or 122 self-citations, all the authors of the citing paper and cited documents were common.

4 The average number of self-citations per paper was 1.06, and the average number of self-citations per paper containing self-citations 2.3.

5 About 12 per cent of all citations was self-citation. And nearly 13.8 per cent of citations to periodical documents was self-citation.

53 Percentage of Self-citations

Table 17 shows the percentage of self-citations in relation to the total number of citations in the case of the contributions, where the phenomenon of self-citation was incident.

531 Table 17. Percentage of Self-citation and Number of Contributions

Percentage of self-citation	Number of contributions
0 - 10	20
11 - 20	36
21 - 30	11
31 - 40	14
41 - 50	14
51 - 60	5
61 - 70	1
71 - 80	1
81 - 90	-
91 - 100	1

532 Annotation

1 The median per centage of self-citations was 20.

2 The average percentage of self-citation was 12.8.

54 Periodical-wise Distribution of Self-Citations

Table 18 shows the periodicals ranked according to the frequency of self-citations. Only the names of those periodicals, cited more than 3 times, are given.

541 Table 18. Rank of Periodical by Frequency of Self-Citations

Rank	Name of Periodical	Self-citations	
		Number	Cumulative total
1	Indian journal of pure and applied physics	56	56
2	Indian journal of physics	20	76
3	Acta crystallographica	9	85
3	Journal of scientific and industrial research	9	94
3	Physical review	9	103
4	Proceedings of the Physical Society, London	8	111
5	Proceedings, National Institute of Sciences of India	7	118
6	Proceedings, Indian Academy of Sciences	6	124
7	Current science	5	129
7	Journal of physics and chemistry of solids	5	134
8	Philosophical magazine	4	138
9	British journal of applied physics	3	141

Rank	Name of Periodical	Self-citations	
		Number	Cumulative total
9	Journal of the Physical Society of Japan	3	144
9	Proceedings, National Academy of Sciences of India	3	147
9	Proceedings of the Royal Society, London	3	150
9	Spectrochimica acta	3	153
9	Zeitschrift der physikalische chemie	3	156
10	(13 periodicals)	2 each	182
11	(41 periodicals)	1 each	223

542 Annotation

1 In all, 72 periodicals contributed a total of 223 self-citations.

2 Sixteen Indian periodicals contributed nearly 53.7 per cent of the self-citations.

3 About 25 per cent of the self-citations was contributed by the Indian journal of pure and applied physics itself-- Out of 64 citations to it, 56 were self-citations.

4 Out of a total of 228 citations to Indian periodicals, 52.2 per cent or 119 were self-citations.

5 More than 50 per cent of the self-citations was contributed by 7 periodicals.

6 About 75 per cent of the self-citations was contributed by 23 periodicals.

7 About 90 per cent of the self-citations was contributed by 49 periodicals.

55 Age of Self-citations

1 The oldest self-citation was of the year 1945 or 22 years old.

2 About 50 per cent of the self-citations was less than 4 years old.

3 About 75 percent of the self-citations was less than 5 years old.

4 About 90 per cent of the self-citations was less than 8 years old.

56 Reason of Self-Citation

From the data available, it was possible to discern a few probably reasons which explain the incidence of self-citation in scientific communication. These may be enumerated as follows:

1 The citing paper continues the work reported in the self-citation;

2 The citing paper reviews the work already done and reported in published papers. The self-citation being one of the papers reporting the work already done;

3 The self-citation dealt with features, such as the design of experiment, equipment, or methodology used in the work reported in the citing paper;

4 The tendency to let one's own work known to others; and

5 The importance of a paper being evaluated by the number of times it is being cited in other papers.

6 CITATION OF PAPERS BY INDIAN AUTHORS

There were 457 citations to periodical documents, of which at least one of the authors was Indian. In other words, nearly 28.3 per cent of the citations was to periodical documents by Indian authors. Out of these, 228 citations or 50 per cent were to Indian periodicals. In other words, nearly 14.1 per cent of the citations to periodical documents was to Indian periodicals. Of these 457 citations, 237 or nearly 52 per cent of the citations were self-citations. Out of these 237 self-citations, nearly 119 or 50 per cent were in Indian periodicals. Thus, nearly 52.2 per cent of the total citations to Indian periodicals were self-citations.

7 CHARACTERISTICS OF REPEATED CITATION

71 Importance of a Paper

The frequency of citations to a paper or the number of times a paper is cited is taken to be indicative of the quality or the impact or the importance of a paper. According to Price " ... some 4 per cent of all papers appear to be "classics", cited four or more times in a year" (2). With this in view, it was decided to study the reasons for incidence of repeated citations in case of Indian physicists. In other words, why one and the same paper is cited in two or more papers.

72 Incidence of Repeated Citation

It was found that a number of citations were common to two or more citing papers. In other words, one and the same paper was cited in two or more citing papers, or more than once in the same paper. Let us denote these citations by the term 'Repeated Citations'. Table 19 shows the number of repeated citations for periodical documents and also for the non-periodical documents.

721 Table 19. Number of Repeated Citations

N of times cited	Periodical document	Non-Periodical Document					
		Book	Technical report	Data publication (Table, Data sheet, etc	Conference proceedings	Thesis	Total
2	71	22	1	3	1	2	29
3	12	6	-	-	-	-	6
4	3	3	-	1	-	-	4
5	-	2	-	-	-	-	2
6	1	-	-	-	-	-	1
7	-	1	-	-	-	-	-
8	2	-	-	-	-	-	-
9	-	1	-	-	-	-	1
Total	89	35	1	4	1	2	43

73 Reason for Repeated Citation

From the data available, it was possible to discern a few factors which explain the incidence of repeated citations. These may be enumerated as follows:

1 Citing papers expounded the same subject-field;

2 At least one of the authors of the citing papers being common -- that is, the incidence of self-citation;

3 At least one of the authors of the citing papers working in one and the same institution; and

4 Cited more than once the same paper.

Table 20 shows the number of repeated citation as against one of the four reasons mentioned above.

74 Table 20. Number of Repeated Citations and Reasons

SN	Reason for repeated citation	Document	
		Periodical	Non-periodical
1	Citing papers expound same subject-field	70	31
2	One of the authors of the citing papers common	67	22
3	One of the authors of the citing papers working in one and the same institution	69	27
4	Cited in the same paper	5	9
5	Others, Indeterminable	6	17

75 Annotation

1 In those cases where more than one reason for repeated citation was discernable, a count was made against each of the reasons.

2 The most important reason for repeated citation appeared to be that the citing papers expound the same subject-field.

3 The other two, more or less equally important reasons for repeated citations, were found to be that at least two of the authors of the citing papers being common, and at least one of the authors of the citing papers working in one and the same institution.

4 The reasons responsible for the incidence of self-citations are very much present in cases of repeated citations also.

8 SUMMARY

1 The average number of citations per page of the Indian journal of pure and applied physics (5) (1967) was 32 -- that is, 320 citations per 100 pages.

2 The average number of citations per contribution was 8.8 -- 10.3 for article and 5.8 for short-communication. The median of citations for contributions was 8 -- 9 for article and 5 for short communication.

3 Though a majority of documents cited were periodicals, the number of citations to non-periodical documents was not insignificant -- it was nearly 18 per cent of the total. The periodicals thus contributed 82 per cent of the citations.

4 255 periodical publications contributed 1616 citations. Twenty-five per cent of the periodical citations was to 4 periodicals; fifty per cent to 17 periodicals; and seventy-five per cent to 53 periodicals.

5 The five periodicals contributing the largest number of citations were the Physical review (178), Journal of chemical physics (108), Indian journal of pure and applied physics (64), Journal of applied physics (60), and Indian journal of physics (48).

6 The 255 periodical publications were published from 20 countries. The first six countries with more than 10 periodical publications each were the United States (85 titles, 680 citations), United Kingdom (42 titles, 278 citations), India (33 titles, 228 citations), Germany (25 titles, 116 citations), Japan (12 titles, 63 citations), and France (12 titles, 25 citations).

7 The citations were largely the periodical publications published in English speaking countries and in English language. Russian periodicals contributed a bare 2.5 per cent of the citations.

8 About 25 per cent of the citations to periodical documents was less than 4 years old, 50 per cent less than 8 years old, and 75 per cent less than 15 years old, at the time of citation.

9 Largest number of host periodical publications was in the field of Physics (68 titles, 752 citations), followed by Engineering (49 titles, 127 citations), Natural sciences (30 titles, 120 citations), and Chemistry (27 titles, 278 citations).

10 About 46 per cent of the contributions carried self-citations, ranging from 1 to 8. The total number of self-citations was 237 -- 223 to periodical documents and 14 to non-periodical documents. About 12 per cent of all citations was self-citation. And about 13.8 per cent of citations to periodical documents was self-citation. The average percentage of

of self-citation was 1288, and the median percentage was 20 (only the contributions carrying self-citations were taken into consideration for calculating the average and median). Sixteen Indian periodical contributed 53.4 per cent of the self-citations. The Indian journal of pure and applied physics alone contributed 25 per cent of the self-citations.

11 About 28.3 per cent of the total citations or 457 citations were to periodical documents by Indian authors. And nearly 14.1 per cent of the total citations -- 228 citations -- were to Indian periodicals.

12 The most important reason for repeated citation was found to be that the citing papers expound the same subject-field. The other two equally important reasons were that at least one of the authors of the citing papers being common, and at least two of the authors of the citing papers working in one and the same institution.

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DRTC Seminar (7)(1969). Paper JC.

UNIVERSE OF SUBJECTS AND DUPLICATION OF DISCOVERY: A CASE STUDY USING STATISTICAL METHODS.

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The kind of ideas added, the mode and rate of their addition, and the process of assimilation of ideas in the universe of subjects affect the work of the librarian -- particularly document selection, classification, reference service, and documentation service. Scientific discoveries constitute one source of ideas. Predictability, unpredictability, and duplication are attributes of these ideas. The proportion of new ideas and duplications in a subject at different periods partly affect the shape of the growth-curve for that subject. Wastage due to unintended duplication, partly arising from a deficient documentation service, is the concern of librarians and of those making policies for the organisation of research and development. These and various other social implications of scientific research are studied by specialists in different disciplines, grouped under the name 'science of science'. Data on the discovery and duplication of antibiotics are presented. Regression analysis, Analysis of Variance, and a Modified Poisson Distribution have been used to analyse the data and study the trend of duplication, the distribution of duplication, and the relationship between duplication and discovery. The findings are: (1) the total number of discoveries, new discoveries, and duplications are predictable by assuming a linear relationship between the respective pairs of variables; (2) the pattern of duplication is not due to chance alone; there is a regularity, in the statistical sense, in its behaviour; (3) the reported discoveries and duplications both increase with time; (4) the behaviour

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of the functional relationship between the number of duplications in relation to time, are different; (5) over the thirty-year period 1937-66, the rate of duplication has nearly halved; and (6) there appears to be a tendency for the cumulative duplication to stabilise at about twenty-five per cent of the cumulative discoveries over the sixty-year period 1907-66. Further work in the subject is mentioned.

1 ADDITION OF IDEAS TO THE UNIVERSE OF SUBJECTS

11 Librarian's Interest

The kind of ideas added, the mode and rate of their addition, and the process of assimilation of ideas in the universe of subjects affect the work of the librarian -- particularly document selection, classification, reference service, and documentation service. Therefore, studies on such processes in the universe of subjects should be of direct interest to the librarian.

12 Scientific Discovery

Scientific discoveries make up a large group of ideas, adding continuously to the universe of subjects. It is a wide spectrum composed of different kinds of ideas -- ranging from an altogether novel idea or a seminal idea at one end, through a series of those amounting to a marginal increment in our knowledge, to the duplicate discoveries, at the other. Thomas Kuhn (7,8) discusses the structure of scientific discovery following a method closely resembling the Spiral of Scientific Method (14). He categorises scientific discoveries into two broad groups:

1 A discovery that is predictable on the basis of existing knowledge; and

2 A discovery that is not predictable on the

basis of existing knowledge, and it gives a new orientation to the thinking in the field of study concerned.

The filling of the gaps in the Periodic Table through the discovery of new elements, and the isolation of antibiotics from micro organisms are examples of discovery of Kind 1. The discovery of Oxygen, of X-ray, and the original discovery of antibiotic are examples of discovery of Kind 2. To these two kinds of ideas, we can add a third group: the unintended duplicate discoveries.

13 Shaping the Growth-Curve

The different kinds of ideas and the proportion in which each of them occur at different periods of time in a subject field, shape the growth-curve for that segment of the universe of subjects. For instance, the introduction of a seminal idea in a subject-field usually accelerates applied and developmental research leading to an almost continuous stream of near-seminal ideas. This could lead to a continuous exponential growth of the subject concerned. However, in most cases, the upper part of the growth-curve begins to bend down or tends to stabilise over a range. This may, at least in part, be due to the increased chances of duplication of discoveries when applied and developmental research accelerates.

14 Wastage due to Duplication

The documentalist is also interested in unintended duplication of discoveries from another angle. Duplication of research effort is a drain on the investment in research and development. A part of the duplication may be due to some deficiency in the information-transfer chain. For instance, on the basis of a survey conducted by Aslib, Martyn writes that the annual cost of unintentional duplication of research in UK, due to the belated availability of information on the project of research, "could easily be double the estimate of £ 6 million" (9). The question, therefore, arises whether a knowledge of the pattern of duplication of discovery in a given field could help in minimising such unintended duplication through a

1 Reorganisation of the research programme;

2 Re-designing the documentation and other services meant to help the research worker in getting published information on the specific subject of his interest at the moment; and

3 Establishing greater coordination and rapport between research team, documentation team, and the document finding system.

15 Wider Context: Science of Science

The study of duplication of research has also much wider implications, when viewed in the broader context of the structure, development, and social implications of science (3,12). The increasing emphasis placed on better utilisation of the findings of scientific research and on the conservation of research potential has, in recent years, led historians of science, philosophers of science, science policy makers, educators, those involved in national economic planning and documentalists to take a closer look at science as a subject and at the people and programmes involved in its development. The questions to which answers are sought relate to the "change of state" taking place in science and its social implications. The topics considered include, among others, the following:

1 Pattern of change and growth of different disciplines and causes for the particular patterns;

2 Rate of change and growth in different disciplines;

3 Social implications of the change and growth of science;

4 Pattern and structure of discovery;

5 Pattern of duplication and simultaneous discoveries;

6 Psychology of scientific research in the context of the dynamism of change and growth of science;

7 Means of communication between scientists, and between the scientist and the comman man;

8 Utilisation of the findings of research in the context of differences in social groups -- state of technological development, educational, historical, political, economical, and sociological backgrounds; and

9 Organisation for research conducive to the development of the disciplines and contribution to human welfare.

Different aspects of the above-mentioned topics have been studied by specialists in different disciplines -- philosophy of science, history of science, social epistemology, statistical bibliography, management of science, etc. Different approaches -- theoretical, descriptive, experimental, and statistical -- to the study of the problems are being tried. Various techniques including statistical calculus and operations research, are being used. A large number of documents dealing with one or the other aspects of the above-mentioned problems have been published in recent years. The questions, for which answers are sought, and the methods and techniques used in finding answers, are now gathered together within the scope of a new discipline called "Science of science". In his book Social function of science (1939), J D Bernal focussed attention on some of those questions relating to the impact of science on society. In celebration of the twenty-fifth year of publication of that book, a symposium on "Science of science" was organised in 1964 (4). The establishment of an international institute for studies in science of science was recommended.

16 Scope of the Paper

As one of the questions in science of science, the incidence of multiple discoveries has been studied among others by Merton and by Barber (1,2). Merton (10) showed that, to a certain degree, the incidence of multiple discoveries obeyed Poisson Distribution. On this, Price remarked (13) "The multiplicity of discovery runs so high in so many cases that one is almost persuaded that it is a widespread occurrence rather than a chance rarity. In an earlier paper (11), some aspects of the discovery and duplication of antibiotics were examined. The problems in deeming the work of isolation of an antibiotic, which is subsequently identified with an antibiotic already reported, as duplication and wastage of research effort were also discussed. In the present paper, besides presenting data on discovery and duplication of antibiotics, an attempt has been made to use statistical calculus to study:

1 The trend in duplication;

2 The distribution of duplication; and

3 The relationship between duplication and discovery.

2 DEFINITION AND NOTATION

21 Definition of Duplication

For the purpose of this paper, a discovery of an antibiotic is considered a duplication if that antibiotic has been identified with another antibiotic already discovered and so reported in published documents irrespective of whether the compounds were produced by the same or different species of micro organisms. There may be several reports on an antibiotic before it is identified with a known antibiotic. The number of duplications is taken as one only in each of such cases.

22 Notation Used

The following notation is used:

X_t = Number of reported discoveries of antibiotics in year t.

Y_t = Number of new discoveries of antibiotics in year t.

Z_t = Number of duplications in year t.

Thus, $X_t = Y_t + Z_t$.

3 DATA ON DISCOVERY

In the present work, the data reported earlier (11) have been used. Scrutiny of the data presented earlier indicated a few minor discrepancies. These have been rectified. Table 1 gives year-wise data on reports on discoveries, new discoveries, and duplications. Table 2 gives detailed data on duplication of antibiotics derived from Fungi and Actinomycetes separately.

31 Table 1. Year-Wise Data on Reports of Discovery, New Discovery, and Duplication

SN	Year	X_t	Y_t	Z_t
1	1937	2	1	1
2	38	3	2	1
3	39	8	8	0
4	40	5	2	3
5	41	3	3	0
6	42	15	7	8
7	43	10	6	4
8	44	20	13	7
9	45	25	17	8
10	46	27	25	2
11	47	54	35	19
12	48	44	36	8
13	49	51	35	16
14	50	42	30	12
15	51	53	37	16
16	52	58	46	12
17	53	68	54	14
18	54	84	62	22
19	55	82	60	22
20	56	72	48	24
21	57	119	91	28
22	58	79	57	22
23	59	95	70	25
24	60	89	69	20
25	61	62	45	17
26	62	93	67	26
27	63	107	77	30
28	64	100	80	20
29	65	83	60	23
30	66	77	60	17
n = 30		$\sum X_t = 1{,}630$	$\sum Y_t = 1{,}203$	$\sum Z_t = 407$

32 Table 2. Data on Frequency of Duplication

N of times re-ported	N of times dupli-cated	Antibiotics from		Total
		Fungi, etc (1907-66)	Actinomycetes (1937-66)	
1	0	371	1,018	1,389
2	1	39	79	118
3	2	12	20	32
4	3	7	15	22
5	4	2	7	9
6	5	4	7	11
7	6	2	4	6
8	7	1	1	2
9	8	-	-	-
10	9	-	-	-
11	10	1	1	2
12	11	1	-	1
13	12	-	1	1
14	13	-	-	-
15	14	-	-	-
16	15	-	-	-
17	16	-	-	-
18	17	-	-	-
19	18	1	-	1
	Total	441	1,153	1,594

33 Annotation

1 Out of the 441 antibiotics derived from Fungi, etc, about 84 per cent were not duplicates, and about 16 per cent were duplicated one or more times.

2 Out of the 1,153 antibiotics derived from Actinomycetes, about 88 per cent were not duplicates, and 12 per cent were duplicated one or more times.

3 Out of the total 1,594 antibiotics derived from the two groups of micro organisms, about 87 per cent were not duplicates and about 13 per cent were duplicated one or more times.

4 It is worth noting that in the case of antibiotics derived from Fungi, etc, the work was spread over a period of 60 years (1907-66), whereas in the case of those antibiotics derived from Actinomycetes, the work was spread over a period of 30 years only (1937-66).

5 The average rate of discovery and the average rate of duplication of antibiotics derived from Fungi, etc, over the 60-year period was 7.4 and 1.2 respectively.

6 The average rate of discovery and the average rate of duplication of antibiotics derived from Actinomycetes over the 30-year period was 38.4 and 4.5 respectively.

7 In the case of antibiotics from Fungi, etc, one out of every six discoveries was a duplicate. In the case of antibiotics from Actinomycetes, one out of every eight discoveries was a duplicate.

8 It is also worth noting that the first antibiotic derived from Fungi etc included in this study was reported in 1907 and the first duplication occurred five years later in 1912. On the other hand, the first antibiotic derived from Actinomycetes included in this study was reported in 1937 and the first duplication did not occur until ten years later in 1947.

4 TREND IN DUPLICATION

41 Index of Trend

An Index I_t (duplication rate) was used to study the trend. I_t is defined as:

$$I_t = \frac{\text{N of duplications upto year t}}{\text{N of reported discoveries upto year t}} \times 100$$

It is obvious that I_t can vary from 0 to 100. A higher value of I_t will mean duplication to a greater extent and vice-versa. Table 3 gives the value of I_t for selected years.

411 Table 3. Value of I_t for Selected Years

Year (t)	Cumulative N of		I_t
	Discoveries	Duplications	
1916	9	4	44.4
1926	12	4	33.3
1931	26	14	53.8
1936	45	21	46.7
1941	66	26	40.0
1946	118	34	28.8
1951	362	105	29.0
1956	728	199	27.3
1961	1,172	311	26.5
1966	1,632	427	26.2

412 Annotation

1 Over the first ten-year period 1916-26, the duplication rate dropped from 44 per cent to 33 per cent.

2 Over the next five-year period 1926-31, the duplication rate increased quite steeply to reach a maximum of nearly 54 per cent.

3 From 1931 onwards, the duplication rate has steadily declined reaching a minimum of about 26 per

cent in 1966.

4 It may be worth noting that over the five-year period 1941-46, the drop in the duplication rate was fairly steep as compared to the steady decline, almost tending to a levelling off, in the next twenty years 1946-66.

5 A possible reason for this kind of picture may be that in the period 1943-66, the researches for the isolation of antibiotics were accelerated to a considerable extent following the debut of pencillin as a "wonder drug" about 1941-2. Therefore, the "production rate" far outclassed the duplication rate during that period.

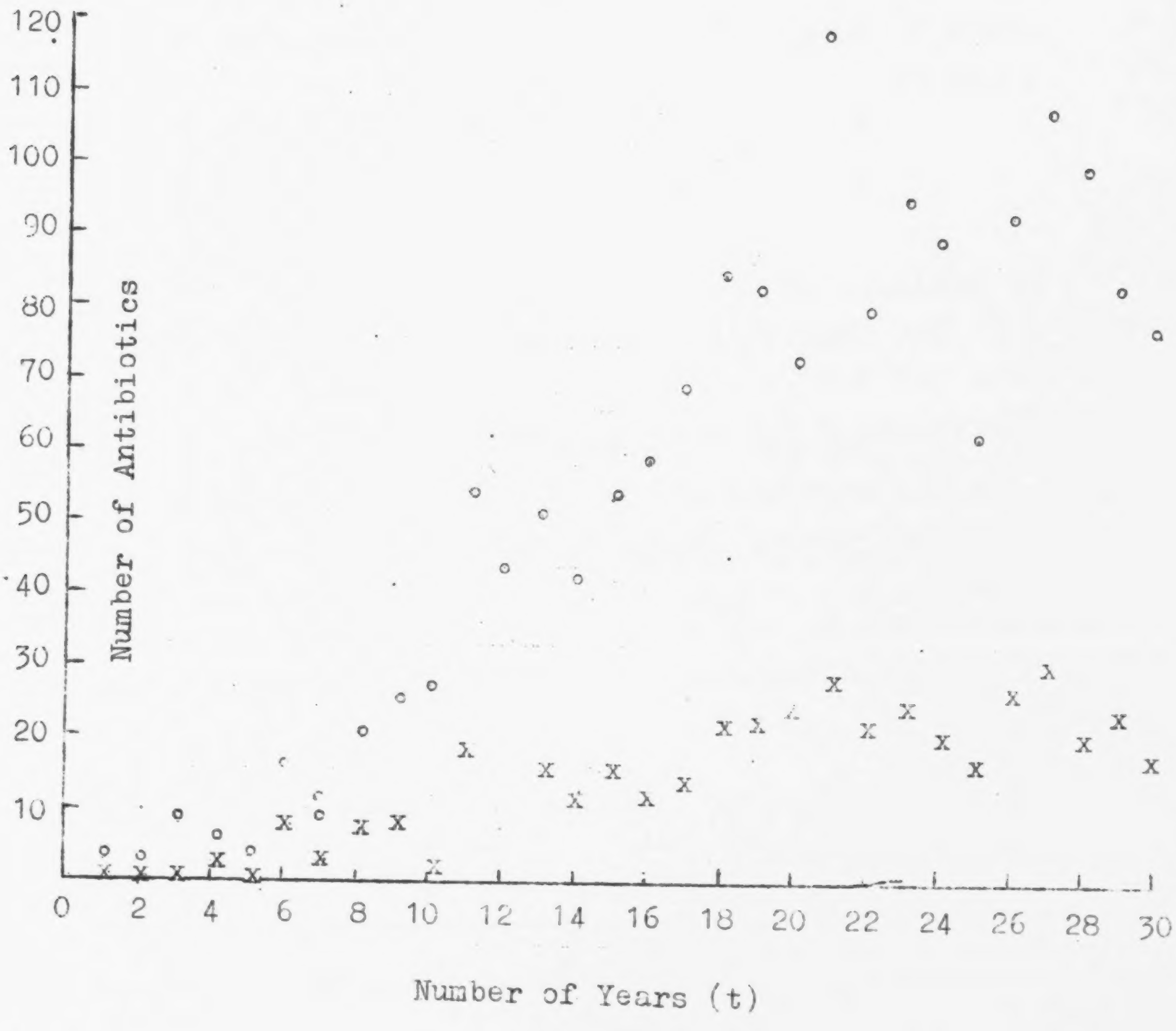
The trend in discovery and duplication during the thirty-year period 1937-66 is examined further in the next section.

42 Trend

The data for X_t and Z_t given in Table 1 in Sec 31 are presented in the form of a graph in Fig 1. It is seen that the number of reported discoveries (X_t) and that of duplications (Z_t) both increase with time. It is also seen that the behaviour of the functional relations (X_t, t) and (Z_t, t) is different. The statistical analysis described below confirms this.

421 Fig 1. Trend of X_t and Z_t

ooo = X_t x x x = Z_t



43 Regression

The following regression relations

$$X_t = \alpha_1 + \beta_1 t$$

$$Z_t = \alpha_2 + \beta_2 t$$

were considered adequate. The unknown parameters α_1, α_2, β_1, β_2 were estimated by the Method of Least Squares. The equations obtained were as follows:

$$X_t = -2.9904 + 3.6983t \quad \ldots\ldots [1]$$

$$Z_t = 0.1609 + 0.9079t \quad \ldots\ldots [2]$$

44 Analysis of Variance

The existence of the regression was confirmed with the Analysis of Variance technique. The ANOVA tables for [1] and [2] are given below.

The expected values of F, χ^2 etc are taken from Statistical tables by Rao and others (15).

441 Table 4. ANOVA for [1]

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Regression	1	30,740.3	30,740.3	144.1	7.64
Residual	28	5,972.4	213.3		
Total	29	36,712.7			

442 Table 5. ANOVA for [2]

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Regression	1	1,852.6	1,852.6	83.8	7.64
Residual	28	618.8	22.1		
Total	29	2,471.4			

45 Heterogeneity of Regression

A further test was done to confirm the heterogeneity of the two regressions. This test is discussed by Kempthorne (5). The ANOVA table is given below.

451 Table 6. ANOVA to test $\beta_1 = \beta_2$

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Common β	1	23,842.99	2,384.99		
Difference	1	8,749.85	8,749.85		
Individual β	2	32,592.84	16,296.42	138.5	5.15
Residual	56	6,591.20	117.70		
Total within sets	58	39,184.04			

Therefore, $\beta_1 \neq \beta_2$

5 DISTRIBUTION OF DUPLICATION

Merton's study referred to in Sec 16 has indicated that there may be predictable regularity in multiple discoveries. Therefore, an attempt was made to fit a known distribution to the data presented in Table 2 in Sec 32.

51 Fitting a Modified Poisson Distribution

A random variable X is said to have the Modified Poisson Distribution (6) if

1 X has Poisson Distribution with λ as parameter; and

2 λ itself has a Gamma Distribution.

In the Modified Poisson Distribution, it can be shown that:

$$\left(\frac{c}{c+1}\right)^{p}\left\{\frac{p(p+1+(p+2)\ \ldots\ (p+(r-1))}{(r-1)!\ (c+1)^{r}}\right\}\ldots\ [3]$$

where p and c are constants which are estimated by using the following relations:

$$\text{Mean of } X = \bar{X} = p/c \quad \ldots \quad \ldots \quad [4]$$

$$\text{Variance of } X = \text{Var}(X) = p/c + p/c^{2} \quad [5]$$

Using [4] and [5], p and c were separately estimated for the data on antibiotics from Fungi etc, Actinomycetes and for the pooled data given in Table 2 in Sec 32. Using [3], the expected frequencies were computed. A χ^2 goodness of fit test was done to examine the goodness of fit. For the purpose of fitting the distribution, the upper tail of the distribution from duplication 8 and above were omitted. Table 7 gives details of the goodness of fit.

52 Table 7. Observed and Expected Frequencies of Duplication, and Test for Goodness of Fit

N of times duplicated	N of Antibiotics from Fungi, etc		N of Antibiotics from Actinomycetes		Total	
	Observed	Expected°	Observed	Expected°	Observed	Expected
0	371	364.2	1,018	1,011.6	1,380	1,380.5
1	39	44.3	79	81.9	118	121.5
2	12	15.8	20	29.5	32	44.2
3	7	6.9	15	13.3	22	20.2
4	2*	3.3	7	6.7	9	10.1
5	4*	1.6	7*	3.5	11	5.4
6	2*	0.8	4*	1.9	6*	2.9
7	1*	0.4	1*	1.1	2*	1.7
χ^2_{cal}	2.98		8.23		12.25	
	9.49 for 4 df		12.59 for 4 df		12.59 for 6 df	

* Grouped data used. °Value corrected to first decimal place

521 Annotation

1 In all the three cases, the goodness of fit was confirmed.

2 It indicates that there exists a predictable regularity in duplication. Merton's findings about multiple discoveries are thus valid in the case of duplications also.

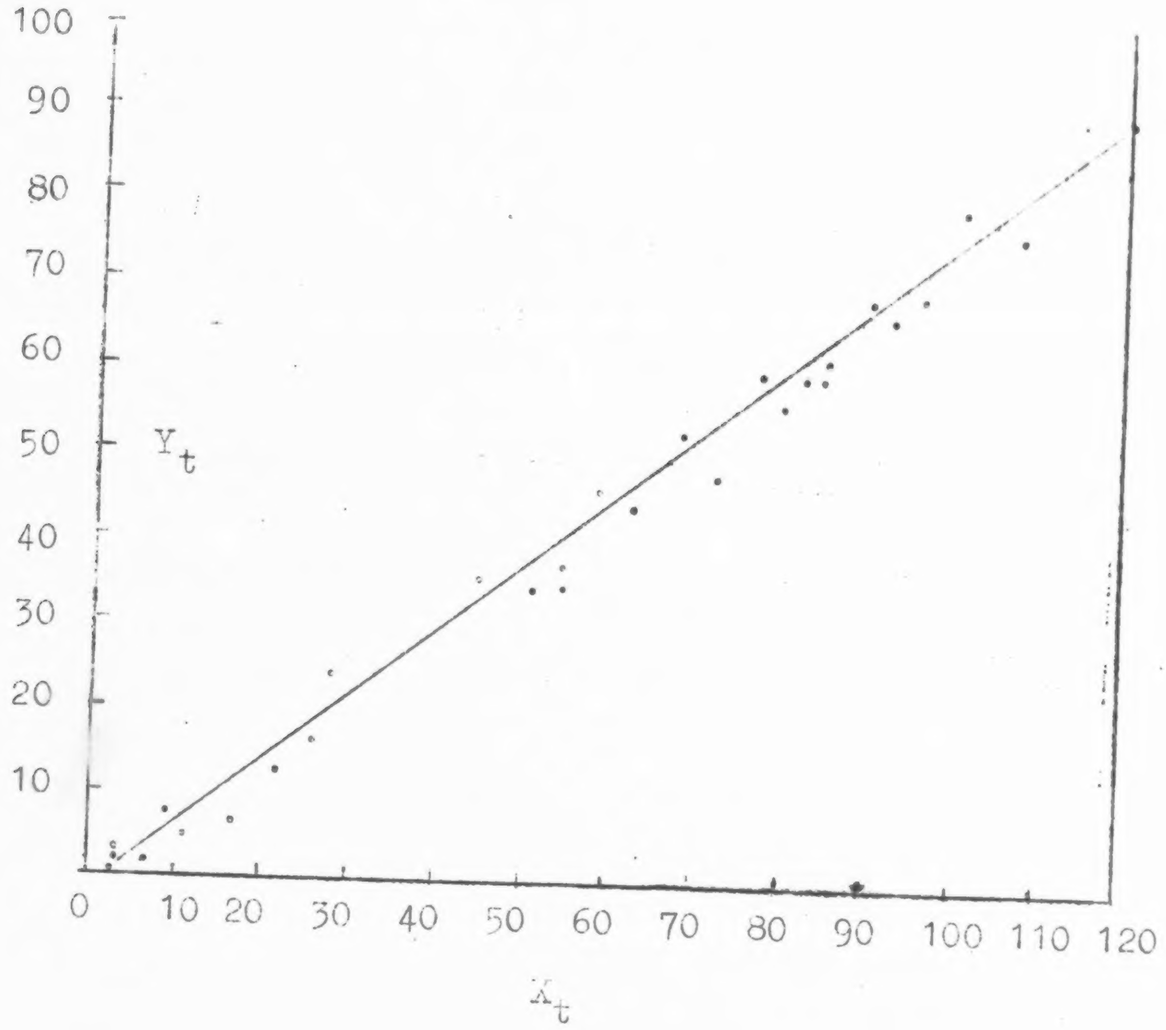
6 RELATION BETWEEN DUPLICATION AND DISCOVERY

It may be seen from Table 1 in Sec 31 that X_t, Y_t, and Z_t generally increase with t. To study the relationships between the three variables, a Regression Analysis was done. The findings of such an analysis would not only indicate relationship between the variables, but also help in predicting the changes in the value of the variables with time.

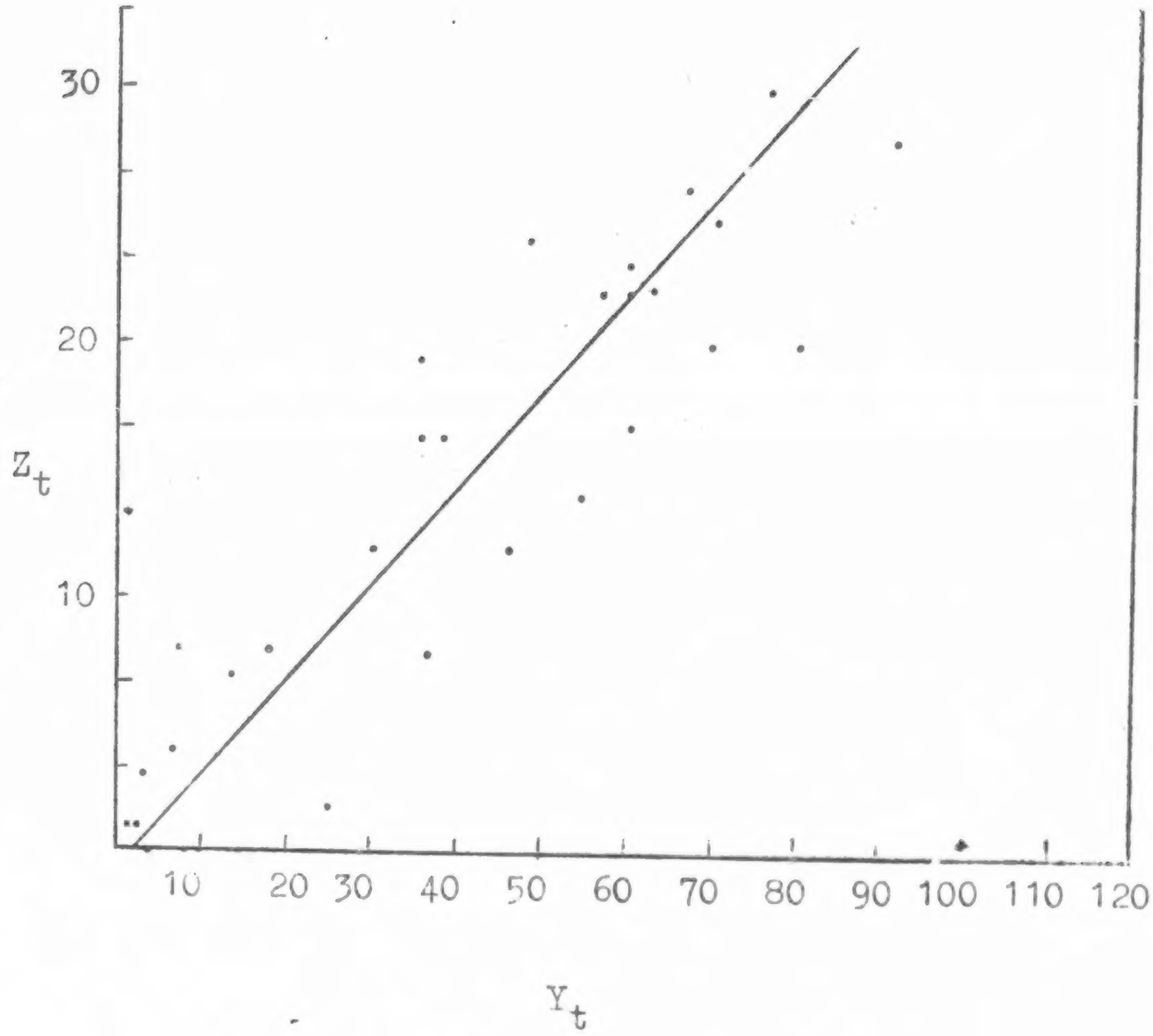
61 Scatter Diagram

Three scatter diagrams were plotted for (X_t, Y_t), (Z_t, Y_t), and (X_t, Z_t) respectively.

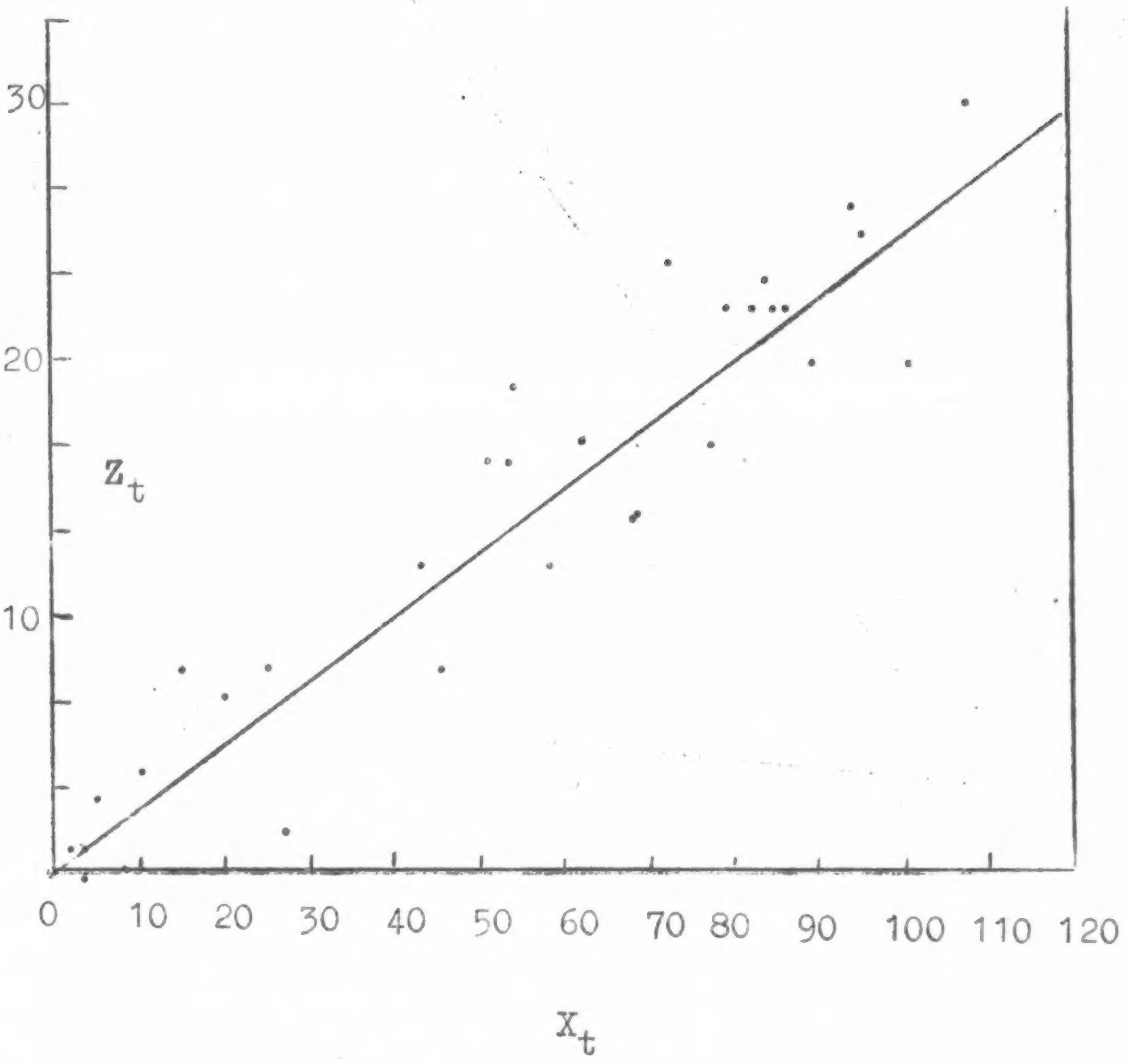
611 Fig 2. Scatter Diagram (X_t, Y_t)



612 Fig 3. Scatter Diagram (Z_t, Y_t)



613 Fig 4. Scatter Diagram (X_t, Z_t)



62 Linear Relation

The scatter diagrams indicate the possibility of a linear relation between the respective pairs of variables. To examine this, the following linear relations were assumed:

$$Y_t = \alpha_0 + \beta_0 X_t \quad \dots \quad \dots \quad [6]$$

$$Y_t = \alpha_1 + \beta_1 Z_t \quad \dots \quad \dots \quad [7]$$

$$Z_t = \alpha_2 + \beta_2 X_t \quad \dots \quad \dots \quad [8]$$

where, α_0, α_1, α_2, β_0, β_1, and β_2 are constants to be estimated from data.

Least square estimates of these constants were obtained by using the data given in Table 1 in Sec 31. The estimated equations were:

$$Y_t = -0.8075 + 0.7529\ X_t \quad \dots \quad [9]$$

$$Y_t = 2.084 + 2.6711\ Z_t \quad \dots \quad [10]$$

$$Z_t = 0.0814 + 0.2471\ X_t \quad \dots \quad [11]$$

621 Residual

Using [9], [10], and [11], the residuals were computed for each case. The values were as follows:

$$\sum (Y_t - \hat{Y}_t) = 0.008$$

$$\sum (Y_t - \hat{Y}_t) = 0.008$$

$$\sum (Z_t - \hat{Z}_t) = 0.002$$

The value of the sum of residues in each case is nearly equal to zero, the theoretical value for a perfect fit of the straight line for the linear relations.

63 Analysis of Variance

The Analysis of Variance technique was used to test the hypothesis:

$Ho_i = \beta_i = 0$ for i = 1, 2, 3 ... ... [12]

Tables 8, 9, and 10 give details of ANOVA tables for the three functions [9], [10], and [11] respectively.

631 Table 8. ANOVA for [9]

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Regression	1	20,809.24	20,809.24	2,539.26	7.64
Residual	28	229.46	8.2		
Total	29	21,038.70			

632 Table 9. ANOVA for [10]

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Regression	1	17,632.82	17,632.82	144.96	7.64
Residual	28	3,405.88	122.64		
Total	29	21,038.70			

633 Table 10. ANOVA for [11]

Source of Variation	df	SS	MSS	F	
				Calc	Exp (1%)
Regression	1	2,242.04	2,242.04	273.75	7.64
Residual	28	229.33	8.19		
Total	29	2,471.37			

634 Annotation

1 In all the three cases, the Null Hypothesis [12] was rejected, thereby indicating strong relationship between the pairs of variables.

2 Therefore, the relations within the observed range of variation, can be used for prediction.

7. SUMMARY OF FINDINGS

The statistical analysis of the data on discovery and duplication of antibiotics has led to the following findings:

1 The total number of discoveries, new discoveries, and duplications in the field of antibiotics are predictable by assuming linear relationships between the respective pairs of variables.

2 The behaviour of duplication of discoveries of antibiotics cannot be left to chance alone. There is a regularity, in the statistical sense, in its behaviour.

3 Over the 30-year period 1937-66, the duplication rate has nearly halved; from about 1 duplicate for every 2 discoveries to 1 duplicate for every 4 discoveries.

4 There appears to be a tendency for the cumulative duplication to stabilise at about 25 per cent of the cumulative discoveries.

5 The reported discoveries and duplications both increase with time.

6 The behaviour of the functional relations (X_t, t) and (Z_t, t) are different.

8 FURTHER WORK

81 In the earlier paper (11), it was reported that

1 The incidence of duplication is highest in the year of report of the original discovery; and

2 The incidence of duplication is highest among the discoveries reported in one and the same country. Additional data has been collected on these aspects of duplication. One of the causes for the pattern in duplication of antibiotics appears to be the particular pattern of publication of reports of discoveries. This conjecture is being examined.

82 Studies of the kind presented in this paper could be done in other fields. Information on the difference in the pattern of duplication of discovery or confirmation of the pattern recognised in the field of antibiotics will then be available for use in predicting the behaviour of duplication of discoveries in general.

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PART K: MANAGEMENT OF TRANSLATION SERVICE

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DRTC Seminar (7)(1969). Paper KA.

TRIANGLE IN TRANSLATION SERVICE.

S R RANGANATHAN, National Research Professor in Library Science, and Honorary Professor of Documentation Research and Training Centre, Bangalore.

Cultural need for the translation of the books of one linguistic group into other languages is mentioned. The part played in the promotion of the translation of books by Unesco in the international plane and by the Union Ministry of Education within India are mentioned. The growing research-need for the translation of microdocuments is traced from beginning of the twentieth century. Self-translation service is now being replaced by the triangle of translation service. Translation service in anticipation by cover-to-cover translation of periodicals and translation service on demand are described. The formation of the triangle of translation service by the establishment of National Translation Centre, the difficulties of the past, and the need for planning for the future, particularly in respect of providing special training for technical translators, are discussed. The need for revision of every piece of translation before despatching it to the party and the advantage of having a Translation Bank are mentioned. The course for documentalist should not include translation work, but should be restricted to the managerial aspect of providing translation service.

1 CULTURAL NEED FOR TRANSLATION OF BOOKS

11 Promotion of Friendly Relation among Cultural Groups

One of the means of promoting a friendly understanding among the national groups in the world and among the linguistic groups in one and the same country, such as India, is to help each group to know about the culture of each of the others. One method for this is the promotion of the translation of some of the outstanding books in each group into the language of each of the other groups.

12 Bilateralism in Translation Service

In the past, translation of books was largely left to casual personal effort. There are many examples of this from very old times down to this day. In translation work of this kind, the producer and the consumer of the translation were the only two essential parties in respect of books. This amounted to Bilateralism in Translation Service intended to serve cultural needs.

13 Triangle Formed in the International Plane

Today, as part of its statutory cultural function, Unesco (= Organ of UN for Education, Science, and Culture) has started the policy of stimulating translation service in respect of the books of the different national groups as part of its cultural function. Its serial, Index translationum: International bibliography of translations, started in 1948, is a token of its interest in this promotional work. Further, this serial discloses the fallow areas in translation service needing to be developed. The promotion role of Unesco has formed a triangle in translation service for cultural purposes.

14 Triangle formed within India

In India, the Union Ministry of Education is promoting the translation of important books from each Indian language into each of the others, as part of the Government's endeavour in the promotion of national integration. This promotion-role of the Union Ministry of Education has formed a triangle in translation service among the languages of India.

15 Role of Library

In the formation of the triangle of translation service of whole books, a library has not had any essential role till now. But the Reference Section of a library can play some part by bringing to the notice of the promoting body the names of the books in different languages for which there is demand for translation into the language of the library. Organisationally it is desirable for the findings of the diverse libraries in a linguistic area to be consolidated by the Library Association of the area and then presented to the promoting body in the sequence of preference.

2 RESEARCH NEED FOR TRANSLATION OF MICRO DOCUMENTS

20 Books in Sciences

The translation of books in Sciences can be and are left to the care of bilateralism as in the case of the books to be translated for cultural understanding.

21 Research-in-Relay and International Economy

Since the beginning of the twentieth century, need has been slowly rising for the translation, from one language into another, of micro documents, such as articles in periodicals, embodying nascent ideas being continuously created by research. This has become necessary in order to conserve the

the research potential of the world. International economy in research requires the avoidance of uncoordinated unintended repetition of the same piece of research in two or more centres, without the knowledge of what has been done elsewhere. Repetition is worth making only for verification and confirmation. On the other hand, what is needed is building further on the basis of what has been done. In other words, research work in the world should be helped as much as possible to run on relay basis. But two factors have been standing in the way of achieving this end: Barrier of Secrecy and Barrier of Language. The removal of the barrier of secrecy is a matter of high level policy. But the removal of the barrier of language is not so.

22 Before World War I

Half a century ago, many of the linguistic communities of the world -- particularly those of Asia, Africa, and Eastern Europe -- were in a state of cultural exhaustion. We may say that they were in one of their periodical rest-phases. Therefore, there was not much of research; and there was little of new micro ideas expressed in the languages of such groups. New micro documents of research value were being produced mostly in a few of the Teutonic and Latin languages only.

23 Self-Translation Service

Before World War I, research was largely solo-research. Further, a solo-research worker is sufficiently high up in the intellectual scale, with capacity to acquire with ease a working knowledge of two or three foreign languages. Therefore, he himself used to do the translation needed by him. Thus, the producer and the consumer of translation service was one and the same. It was a case of Self-Translation Service.

24 Between World Wars I and II

241 Russian Documents

After World War I, some of the Slavonic people -- particularly the Russians -- recovered from their rest-phase. They began to produce a considerable amount of micro documents of research value. But there developed the so-called "iron curtain" surrounding those countries. There was not much of a wish in the countries outside the "curtain" to have access to the ideas created inside the "curtain".

242 Distortion of Librarian's Function

After World War I, solo-research slowly began to give way to team research. Many of the members in the team did not occupy as high a place in the intellectual scale as a solo-research worker did in the earlier periods. They could not learn several languages and do self-translation service. The community also found it uneconomical and unwise to allow these research workers to spend much of their time in translation work. But in avoiding Scylla, they dashed against the Charybdes. The librarian himself was expected to do translation service. For example, in 1924 the Indian Institute of Science advertised for the librarian's post, stipulating that ability to translate from foreign languages into English was an essential qualification and that familiarity with library work would be taken as desirable. One of my colleagues in the Precedency College, who was Latin Master and knew some European Languages, was appointed to the post. This tradition could not be broken till 1951.

243 Distortion in Librarian's Education

When I joined the School of Librarianship of the University College (London) in 1924, learning of two European languages was compulsory. After going through the grind in the elementary grammar of the two languages for two weeks, I told the Director of the School that this part of the course would hardly be of any use to me. I was exempted. Unfortunately, even today some of our universities load the curriculum for librarians by prescribing the study of a language or two. This may have to be attributed to several causes:-

1 Teaching of repetitive library routine is taken to be the main objective;

2 There has been little realisation of the need to teach library science as a professional subject;

3 There is hardly any attempt to teach library science as a descipline based on its own fundamental laws, leading to continuous improvements in library techniques to meet the changing social demands on the library;

4 Hardly any research is being done in library science by the teachers of library science in many universities; and

5 It is not realised that teaching can only be transmissive and not creative and inspiring, unless it is research-based.

25 Barrier of Secrecy being Reduced

It is now being increasingly realised that science is international unlike culture. Therefore, there is a tendency to reduce the Barrier of Secrecy in respect of nascent micro ideas in the sciences -- natural as well as social.

26 Increase in the Languages Embodying Research Results

After World War II, many of the Asian and African people have recovered from their rest-phase. They are now bursting into new intellectual life. The Chinese, the Japanese, and the Indians are examples. The Chinese and Japanese use their own respective languages for the micro documents embodying the results of their research. Due to historic reasons, India is using English as the medium, though there is a desire to change over to the Indian languages. On the whole, there are nearly 80 languages in which micro documents are beginning to appear. It is no longer possible for a research worker to know all the foreign languages in which valuable results of research in his own field are being published. Nor can he ignore them except at his own peril.

27 New Look on Translation Service

Due to the increase in the languages of the micro documents of research, the reduction in the Barrier of Secrecy and the increase in the number of micro documents produced in a year, the translation work to be done has increased considerably. The work of the librarian, involved in serving micro documents to research workers has become, an exacting full-timed work. It needs also continuing improvement of library techniques. To emphasise this he is now called a Documentalist. His time is not available for translation work. Nor is the time of the research workers themselves available for the purpose. Therefore, after World War II, a new look and rethinking have taken place in respect of translation service.

3 TECHNICAL TRANSLATION PROFESSION

31 Division of Labour

Sec 27 suggests a further division of labour in serving research workers. This highlights the importance of recognising Technical Translation as work for a new profession. Its qualifications and strength should be examined.

32 Knowledge of the Technical Jargon of a Subject

Three parameters govern the work of a translator -- translated-from language, translated-into language, and the subject of the micro document translated. That the translator should have a knowledge of the two languages goes without saying. But, this is too loose a statement. For, the language of a micro document embodying nascent idea in any subject is not just the natural language in which the document appears to be. In reality, it is a Technical Jargon of the natural language. The semantic content of a word in the Technical Jargon is often different from that of the same word in the natural language. The translator should therefore be well-versed in the Technical Jargons of both the languages pertaining to the subject of the document.

33 International Nomenclature

In a subject in which an international nomenclature has been established, the translator should know it. International nomenclature is being established for several subject fields by their respective International Committees. Biological Sciences have made good progress. The progress in Physical Sciences is less. Hardly anything has been done in the Social Sciences; it has not been done to any stable degree even within a natural language. But in no subject field international nomenclature is complete. Therefore, there will always be a residue of Technical Jargon in each of the languages for each subject.

34 Treachery of Homonyms and Synonyms

A translator should be fully conversant with the trecherous nature of the homonyms, outside the established Technical Jargon in a subject-field. The synonyms are even more trecherous. For, it is seldom that they are co-extensive in their semantic content. The co-extensiveness may be anything between the full one at one extreme and a very slight one at the other extreme. In the Social Sciences, the undertones and the overtones going with a word create an additional difficulty in translation work. Any mistake due to homonyms and synonyms will distort the translation even to a dangerous extent. The avoidance of this requires that the translator should have a fair knowledge of the subject-field.

35 Education of Translator

It is generally believed that a general course in a foreign language is a sufficient qualification for a translator; with this view, some of the Indian universities are giving general Diploma Course in some foreign languages. I realised the fallacy of this idea to a considerable extent during my visit to the Humboldt University in East Berlin in 1961. There the Departmental Head told me that he was considering regulations for the training of technical translators. The intention was that each translator should qualify himself during the course of sutdy for translation of nascent documents in one or two specified subject-fields from a specified language into German. If there are L translated-from languages and S subject-fields, the ideal will be to have LS courses for translators. We shall denote this hereafter by the term 'LS-Combination'. No doubt, this is an ideal to be aimed.

4 TRANSLATION IN ANTICIPATION: COVER-TO-COVER TRANSLATION

Cover-to-Cover Translation of foreign periodicals is in wide practice in USA. For example its National Science Foundation sponsored in 1965 the translation of one Chinese periodical in Mathematics; one Japanese periodical (one in Electrical Engineering and one in Electronics); eleven Polish periodicals (made up of one in Physics, one in Biochemistry and nine in Medical Sciences); and nine Yugoslavian periodicals (made up of one in Physics, one in Chemistry, one in Medical Sciences). Russian accounts for the largest number. In 1949, the first attempt at cover-to-cover translation of a Russain periodical into English was made in USA. It was the translation of the *Zhurnal Obshchei Khimii* (*Journal of General Chemistry*), a monthly publication with an annual subscription of about Rs 900. By 1968, the number of cover-to-cover English translations of Russian periodicals reached 161 in USA, UK, and Canada taken together. The average annual subscription to them is about Rs 600. The annual subscription to all of them will be about Rs 100,000. Certainly no library in India can afford it. Then there is the question of the foreign exchange. If it is available, either the National Central Science Library can take all of them and make them available to any other library; or the responsibility for their subscription may be distributed among the libraries of universities, research institutions, and industries. Anticipated translation work of this kind will be possible only in countries of great affluence. Naturally, USA leads in this matter. Indeed, it produces about 137 of the 161 cover-to-cover translations and perhaps it itself subscribes for most of the copies produced in translation. India cannot afford to do such anticipatory translation until its national income increases many fold. But even now it is worth comparing the relative cost of:-

1 Subscribing for the English translations; and

2 Subscribing for the Russian originals and translating articles on demand only.

5 TRANSLATION ON DEMAND

51 Local and National Triangles of Translation Service

What India and many other newly developing countries do at present is translation of research articles on demand. Even this, it will have to do in three stages. To facilitate description, India is taken as the type and English is taken as the as the translated into language:-

1 The National Translation Centre may translate the titles of the articles in the current issues of the non-English periodicals taken in the country. These translations of the titles may be furnished along with the titles of the English articles, in a weekly, fortnightly or monthly serial. This was put down as the first function of Insdoc at the time of its establishment in 1952.

2 If any reader is attracted by the title of an a article and desires to have a translation of its abstract one of two things may be done:-

21 If the periodical is in his local library and somebody in the locality can give the gist of its abstract in the language of the library, that library can get it done for the reader; or otherwise, it may send a copy of the abstract to the National Translation Centre for the subject-complex concerned and ask it to provide its translation;

22 If the periodical is not in the local library, it may ask the National Translation Centre to get a copy of the abstract from some other library and provide its translation; and

3 If after perusing the gist or the translation of the abstract, the reader wishes to have the translation of the article, the local service library may request the National Translation Centre for a translation of it. An organisation of this kind introduces a triangle of translation service, both at the local level and at the national level, made of the producer, the promoter, and the consumer.

52 Location of National Translation Centre

There should be a National Translation Centre for each subject-complex for which there is a National Central Library -- such as National Central Library for each of the subject-complexes:-

1 Mathematical, Physical, and Earth Sciences, and their applications;

2 Chemistry and Technology;

3 Plant Sciences, that is Botany, Forestry, Agriculture and other applications;

4 Animal Sciences, that is Zoology and its applications;

5 Biology and Medical Sciences; and

6 Social Sciences.

Each National Translation Centre Should be located in the National Central Library for the subject-complex concerned. The National Documentation Centre for a subject-complex should also be located in that library. Then only the Library, the Translation Centre, and the Documentation Centre in each subject-complex can work in intimate co-operation and secure national economy.

The organisation suggested above is possible only in a country with considerable research activity in all subject-fields. For a country in the early stages of development, it should be treated only as a blue-print of the ideal towards which it should move.

6 TRANSLATION SERVICE IN INDIA

61 The Past

The number of pieces to be translated was 159 in the first year of Insdoc (1952). It grew to 760 in 1960. In 1968, it had grown to 828. Access is not available to published data about the break-down of the 828 translations of 1968, according to each LS-Combination and about the total number of standard pages (say, a typed page of 300 words) of translation done in each LS-Combination. We only read or hear that there is much delay in the supply of translations. This alone does not serve much purpose in improving the service. There are said to be staff translators in a number of institutions in the country. Published data along the lines mentioned above are not available in these cases also. Nor have we reliable data about the number of translator-man-hours available in a year for each LS-Combination, for translation work on contract. Thus experience of the past has not been properly quantified so as to make the basis for planning translation service in the future.

62 Survey

In planning for the future the first step should be to make a satisfactory survey to get quantitative data on all the points mentioned in Sec 61 and other relevant points that may suggest themselves in the course of the survey. The service of a statistician should be used in:-

1 Planning the survey;

2 Supervising the survey; and

3 Deriving, from the data collected from the survey, a suitable plan for organising the translation service of the country and for regulating the production of full-timed or part-timed translators for LS-Combinations. The plan produced

should provide for the needs of the immediate future. There should also be a perspective plan giving a rough indication of how the plan should be varied from time to time.

63 Training of Translation Personnel

It is conjuctured that except where cover-to-cover translation of periodicals is made, it will not be practicable to have a full-timed translator, the discontinuity of the flow of the demand for translation will cause difficulty. Therefore for a considerable time, the National Translation Centre for any subject field cannot get the work done through its staff-translators alone. The translation work will have to be done largely on contract basis. Therefore the education of the translation personnel for each LS-Combination should aim only at producing translators for part-time translation work on contract. These will have to spend most of their time either in research or in post-graduate teaching in their respective subject-fields. As research-mood intensifies in our people, it will be difficult to get a research worker to do translation work. Therefore, the contract work will have to be entrusted mostly to such post-graduate teachers as are not deeply involved in research work. Such post-graduate teachers may take up translation work during their leisure time, as a source of additional income even as examination work is. The learning of a new language and of translation from it is best done in the under-graduate stage. But it is impossible to decide which under-graduate should be given a course of training in translation. The only thing that can be done is to publicise among the undergraduates the chances for part-time translation-career likely to be available for them. The names of the universities and the other organisations giving part-time courses in translation for each LS-Combination should also be widely publicised. Apart from this the UGC or some other appropriate All India Organisation should study the requirements of the country in respect of translators and arrange for the courses in translation work for each LS-Conbination being conducted in suitable universities. It is only a probability and not certainty that can form the basis for this work. This emphasises the need for a satisfactory survey along the lines mentioned in Sec 62.

7 ACCURACY AND ECONOMY

71 Provision for Revision of Translation

Accuracy is essential in translation work. But as the saying goes, it is human to err. Further the tendency to translate the word instead of the idea behind it dies hard. To guard against inevitable error, the translation done by one person should be revised by another person specialising in the same LS-Combination. In fact each such pair of translators should be alternated between translating work and revising work, so that both of them improve in their work and accuracy is ensured.

72 Provision for Economy in Translation Work

We should avoid re-translating one and the same micro document at a later time. For this purpose the National Translation Centre should maintain a Translation Bank consisting of copies of all the Translations made from time to time. A further step in economy will be for our National Translation Centre to form a member of the grid of the National Translation Centres in all the English speaking countries. Each member of the grid should pass on periodically to every other member a card in the standard size, containing in the standard form an account of each translation added to its own Translation Bank.

73 Work of the Staff-Translator

A Staff-Translator of a National Translation Centre may himself do the translation work or the revision work of a document falling within his LS-Combination. He would also control the flow of translation work from the moment a request for translation is received and registered until the final translation is despatched to the party and the payment due from the party is collected and the translating contractor is paid. He should maintain detailed statistics of the translation work done during each year for every LS-Combination in terms of the number of standard pages, and all other relevant details. It is on the basis of such statistical data that the details for the organisation of the translation work can be improved from year to year.

8 PLACE OF TRANSLATION IN THE TRAINING OF DOCUMENTALISTS

The documentalist of a library or of a National Documentation Centre will not be a producer or a consumer of translation service. He will only be the promoter and the middle man in the triangle of translation service. Therefore the training for a documentalist should not include translation work. It should include only the necessary and sufficient information for the managerial work connected with getting the translation done for the readers.

DRTC Seminar (7)(1969). Paper KB.

RESEARCH AND DEVELOPMENT AS A FACTOR IN PLANNING TRANSLATION SERVICE: A CASE STUDY OF MINING ENGINEERING.

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The languages and the subject-fields in which translations are predominantly required at present and the likely trend in the requirement in the near future are factors to be taken into consideration in planning translation service. The trend of research and developmental work in different subjects in the country and the fact of its being influenced by the work done in other countries are factors affecting the focus of attention in subject fields and languages from time to time. Some topics in mining and allied subjects are of immediate interest to India; other subjects are likely to become important and focus of attention in the future. A survey of such areas of interest gives some idea of the languages from which translation would be required at present and in the near future. In the field of mining, documents in the East European languages, French, and Japanese have relevance to the research and developmental work done in India. Information on the experience of the Cultural Mining Research Station, Dhanbad, is presented.

0 FACTORS IN PLANNING TRANSLATION SERVICE

01 Language and Subject

In planning an efficient translation service -- whether it be at the national level or at the level of a particular institution -- there are two basic factors to be considered. These are:

1 Language

11 The languages from which translations are required at present;

12 The likely significant shifts and changes in the requirement mentioned at 11 in the near future; and

2 Subject

21 The principal subject-fields in which translations of documents are required at present; and

22 The likely significant shifts and changes in the requirement mentioned at 21 in the near future.

Obviously, the planning for raising the necessary number of personnel for translation in terms of the subject-language combination, will be based on the factors mentioned above.

02 Trend of Research and Development

The requirements mentioned in Sec 11 are likely to be affected indirectly by a number of social factors. The factors directly affecting the context are mainly two. They are:

1 Research in the country

11 The research and developmental work done in the country in different subject-fields;

12 The likely trend of research and developmental work in the country in different subject-fields; and

2 Research in other countries

21 The research and developmental work done in other countries in different subject-fields; and

22 The likely trend of research and developmental work in other countries in different subject-fields.

03 Need for Survey

The discussion in the preceeding sections indicate that there should be periodical surveys and collection of data on the research and developmental work in different subject-fields in this country and in other countries of the world. Such surveys could provide adequate data on the basis of which the translation service and the training of translation personnel may be planned effectively.

In this paper, as a case study, an attempt is made to examine the main topics and the trend of research and development in the field of Mining in India and in some other countries where the subject has advanced to a great extent.

1 MINING IN INDIA

11 University Course

Mining and subjects allied to it have been taught in India for the last four decades. Postgraduate degree courses in Mining Engineering were started about a decade ago. The number of research papers in the subject written by research workers, engineers, and teachers has been increasing over the years.

12 Documents Relevant to Work in India

In examining the documents on Mining and allied fields produced in other countries, the applicability of the technique etc dealt with to Indian conditions should be borne in mind. Here is an example. Coal output in India has remained almost static at about 65 million tonnes per annum. Indian coal seams are very thick and have a high seam density with varying gradient. The mining method adopted is predominantly "room and pillar". Long-wall mining is being used in some mines that have reached great depths. Unless the target is raised every 5 years by about 30-40 million tonnes, it may not be possible for India to use new mining techniques being developed in other countries.

13 Survey of Trend

In the succeeding sections a brief survey is presented of the developments in major fields of Mining in India in relation to world trends.

2 COAL MINING AND MINE MECHANISATION

21 Work done

211 India

Thick coal seam with high seam density and mining by the 'Room and pillar' method are predominant features. Further, the mining industry is a labour intensive industry.

212 Other countries

The countries in which the condition of coal mining similar to those in India prevail are:

China (Mainland)
USSR
Poland
USA

213 Annotation

Some of the methods used in USA, Poland, and USSR are known in India. But the documentation is inadequate. Our information about the work done in China is practically negligible.

22 Recent Development

221 Hydraulic Mining

USSR employs underground hydraulic mining. It has not been tried in India, and is not likely to be adopted here for another decade or so.

222 Underground Gasification

Experiments and trials in underground gasification are going on in several countries. There is no immediate active interest in the subject in India.

223 Mining of Thick Coal Seam

The technique of thick coal seam mining by caving in descending order with artificial netting is widely used in France and USSR. Only one mine in India has successfully adopted it. There is considerable scope for use of the technique in India in the future.

3 MECHANISED OPEN CAST MINING

31 Work Done

311 India

The mining conditions vary widely in India. Indian mining is labour intensive and most of the mines are small and privately owned. There is, however, scope for adopting mechanised methods at least in a few cases.

312 Other Countries

USA, USSR, and some other countries in Europe are using mechanised open cast mining on a large scale.

32 Recent Development

321 Hydraulic mining

The position is similar to what has been mentioned in Sec 221.

4 BLASTING AND DRILLING

41 Word Done

411 India

In India, the research and developmental activity in blasting and drilling is very little at present. These are neglected branches of the Indian mining industry.

412 Other Countries

Considerable work has been done in Europe, USSR and USA to find out the most efficient pattern of drilling under different conditions, and development of new explosives for blasting.

42 Recent Development

421 Pre-splitting Technique

The pre-splitting technique has not been tried in India, but its use can be explored on a large scale even with the existing facilities. Norway, Sweden, USA and a few other countries are already using this technique.

422 Mass Blasting

The state of mass blasting technique in India and abroad is similar to that of Pre-splitting Technique (See Sec 421)

423 Nuclear Blasting

Nuclear blasting is used to gain low and subgrade coal. It involves a considerable amount of initial expenditure to set up large mining and ore dressing plants. In countries such as USA and

USSR experimental work is in progress in this field. At present, nuclear blasting is mainly of academic interest in India. However, some experiments may be done with help from the Atomic Energy Commission.

424 Ammonium Nitrate and Fuel Oil Explosives

Ammonium nitrate and fuel oil explosives are fairly widely used in USA, Canada, West European and East European countries. Little work has been done in this field in India. Due to fertilizer shortage, ammonium nitrate is not likely to be widely used in mine blasting for some time.

5 ROCK MECHANICS AND STRATA CONTROL

51 Work Done

511 India

The subjects of rock mechanics, strata control and design of new supports are being taught in the courses in India during the last five years. There are few specialists in the subject in the country. The subjects are, however, likely to become quite important as our mines become deeper.

512 Other Countries

Appreciable advances have been made in the study and application of rock mechanics, strata control etc in USA, UK, Poland, USSR, West Germany and East Germany.

6 OPERATIONS RESEARCH AND COMPUTER USE

61 Word Done

611 India

The application of operations research in mining engineering and management is being adopted in an increasing measure in India. Very few mines are, however, in a position to instal a computer for analysis of data and for other computational purposes. The initial capital expenditure is quite high. Specially trained staff will be necessary. Only the large mines and government undertakings can possibly fully utilise the output of computers.

612 Other Countries

USA and Canada have made considerable progress in the application of operation research and computer, in the mining industry. In USSR also this trend is evident in recent years.

7 CONCLUSION

71 Assessment of the Position

It is probably time that a committee of experts in the field of mining and allied subjects makes a detailed assessment of the work done and advances made in the mining industry in India, and its problems of development. It can then outline helpful lines of developmental work taking into account the adaptation of the work done in other countries to suit Indian situation. With the help of experts in documentation the assessment could also cover the problems of documentation and translation in the mining industry. What could be done by way of documentation service at the national level for the mining industry could then be planned on the basis of reliable data. For example, in the UK the National Coal Board, and the Safety in Mining Research provide anticipatory documentation service and abstracting service in the respective subjects coming under their perview. The coordination and cooperation of the documentation and translation activities in mining and allied fields now available or proposed to be developed in the academic institutions, research organisations, and mining establishments will lead to a more efficient and economical service to the mining industry in India.

72 Translation Problems

The information presented in Sec 2 to 6 give a broad indication of the potential areas of research and development in mining engineering and allied subjects in India. There are appreciable developments in Europe and China in certain subject fields of interest to the Indian mining industry. The documents in mining and allied subjects produced in those countries would in particular raise the question of translation. Even in the context of the limited work done in India this question is encountered as indicated by the data given in the following table.

Data on Translations purchased or received by the Central Mining Research Station, Dhanbad. (1964-mid 1969).

SN	Language	N of translations purchased	N of pages
1	German	60	950
2	French	50	810
3	Russian	18	194
4	Japanese	13	156
5	Polish	2	22
		143	2,132

Thus, even now in CMRS alone each year about 32 articles involving about 380 pages are required as translation from different languages.

The majority of the translations were got done by Insdoc, New Delhi. The time taken for getting a translation done varied from 1 to 3 months depending upon the language and the number of pages. A few of the translations from Russian were done by me. A few others were received as gift from foreign libraries.

8 ACKNOWLEDGEMENT

The author is grateful to Prof A K Ghosh, Professor of Mining Engineering of the Indian School of Mines and Geology, Dhanbad, and to Dr R N Chakravarty, Scientist, CMRS, for their valuable suggestions. My thanks are due to Dr K N Sinha, Director, CMRS for permission to contribute this paper to the DRTC Seminar (7) (1969). The views expressed in this paper are mine and not necessarily of the CMRS, Dhanbad.

DRTC Seminar (7)(1969). Paper KC.

SOME ASPECTS OF TRANSLATION SERVICE: A CASE STUDY OF GLASS AND CERAMIC TECHNOLOGY.

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The demand for translations of articles in the field of Glass and Ceramic Technology is increasing. The aids to the selection of documents for translation are not adequate. Through a series of conferences and seminars the problems of translation have been considered and some useful studies have been made. But some of the basic problems of organising an efficient translation service adequate to the needs of the country remain without satisfactory solution. Individual libraries meet the translation problem on an ad hoc basis within their means. Cover-to-cover translations of periodicals are useful but costly. Quality of translation depends on the translator bringing to bear on the translation work a good knowledge of the translated-from and the translated-to language and a fair grasp of the subject dealt with. The panel system of translation has not always been satisfactory in this regard. The establishment of a National Translation Centre is suggested.

1 DEMAND FOR TRANSLATION

In the field of Glass and Ceramic Technology, as in most other fields of Technology, the number of documents in languages other than English has been increasing over the years. About 18 per cent of all the periodicals received in the Central Glass and Ceramics Research Institute, Calcutta, are in languages other than English. The languagewise breakdown of the periodicals is as follows:

SN	Language	Number
1	German	15
2	French	9
3	Russian	7
4	Polish	5
5	Japanese	4
6	Rumanian	3
7	Czechoslovakian	3
8	Italian	2
9	Hungarian	2
10	Dutch	1
11	Swedish	1
12	Spanish	1
	Total	53

The articles published in these periodicals are of relevance to the work of the Institute. The starting of courses in Glass and Ceramics in India has added to the demand for information on work done in this field in other countries.

2 SOME AIDS IN SELECTION

In selecting articles for translation, the following are helpful:

1 The title of the article translated into English given in the contents page or elsewhere in the periodical itself;

2 The abstract or summary of the article in English given in the periodical itself; and

3 The abstracts of the articles given in some abstracting periodicals.

These aids are not, however, adequate. Some of the periodicals do not carry either an abstract in English or even a translation in English of the title of the article. Secondly, not all the articles in periodicals are indexed or abstracted in the abstracting services covering the field of Glass and Ceramics. Thirdly, there is a gap of a few months between the publication of an article and its indexing/abstracting in an international documentation periodical.

3 CONSIDERATION OF SOLUTIONS

The problems of scientific and technical translation have been examined by UNESCO and a monograph was published in 1957. The Third Congress of the International Federation of Translators (FIT), which met in Bad Godesberg in 1959, provided some purposeful discussions on the subject (1). The Conference of Information Scientists held in Mysore in 1963, considered the problem with particular reference to the Indian situation (2). A full-fledged Seminar on Translation was organised by Insdoc in 1965 (3). Several useful studies have been made and some of the recommendations of the various seminars and conferences have been implemented.

4 BASIC ISSUES NOT ADEQUATELY TACKLED

Some of the basic problems of management of translation services,.however, remain without adequate solution. Each library or documentation unit tries to find ad hoc or temporary solution to the problem, within the limited means at its disposal. For instance, while at the Forest Research Institute, Dehra Dun, I could get help from some foreign-language-knowing research staff for translation work and even to conduct classes in one or two foreign languages for the benefit of the other members. Where there is a regular translation unit, the translators may conduct such language classes. This is indeed a common practice in several institutions. It is obvious that taking the help of the research staff in translation work has its limitations. For instance,

1 There may not be members on the research staff knowing the language from which translations are frequently required;

2 The help from a research worker very much depends upon the time at his disposal and his willingness to do translation work even if he has any spare time; and

3 The research worker may, at the most, be able to help himself, but not be able to meet the translation demands of all his colleagues.

5 NATIONAL LEVEL

51 Panel System

At the national level, traslation service is provided by such organisations as the Insdoc and the Iaslic through the Panel System (3). In the Roster of Indian scientific and technical translators compiled by Insdoc (1967), the names and addresses of 603 translators are given. About 63 per cent of the persons listed know only one language. A small percentage can translate from three or more languages, as indicated below:

SN	N of languages known	N of persons in Roster
1	1	381
2	2	137
3	3	35
4	4	15
5	5	13

6 QUALITY OF TRANSLATION

61 Subject-Language Combination

It is generally accepted that close collaboration between the translator and the subject specialist is necessary to achieve good results in technical translations. The ideal would be a translator who is also a specialist in the subject of the document translated. In addition to a good knowledge of the translated-from language and the translated-to language, the translator must have a "feeling" for the subject. Translation services based on the Panel System of translators appear to be working at a disadvantage with respect to the quality of translation. Seshadrinathan, in a study of the problem, has indicated that the Panel System has been a partial failure (6). The study by the Unesco has pointed out that translation service by institutions employing subject specialists on their staff are able to provide more efficient and qualitatively better translations. Even when the translator is not a specialist in the subject of the document to be translated, he can do an adequate and acceptable translation work if he is, in addition to knowing the languages, gifted with commonsense and general knowledge, and has a good cultural background and access to good glossaries, dictionaries, and other reference books, helpful in his work. A translation is considered good when it can give the same effect as that of the original. In the words of S P Zilaphi, Secretary General of the Association of Italian Translators and Interpretors, "for having an equivalent effect as that of the original, the translator must be able to overcome, and with style, the difficulties inherent in the conceptional and expressive differences of the two languages."

62 Terminology

A great deal of the difficulty in translation lies in translating technical terms. The terminology of several of the scientific and technological disciplines are not adequately developed in different languages. A technical dictionary may sometimes wrongly identify a term or give variant meanings. This has been my personal experience on a few occasions while translating some papers on Silviculture, and Entomology. The errors were then rectified with the help of the subject specialists. In recent years, emphasis has been placed on the compilation of multi-lingual dictionaries for various disciplines. A large number of them hae already been published (4).

63 Cover-to-Cover Translations

Cover-to-Cover translations of pericdicals is now one of the accepted means of overcoming the language barrier in the field of Science and

Technology (5). There are a few cover-to-cover translations of the following Russian periodicals useful in the field of Glass and Ceramics and related subjects:

1 Steklo i keramika
2 Zhurnal fizicheskoi khimii
3 Ogneupory
4 Optika i Spektroskopiya
5 Zhurnal prikladnoi khimii
6 Fiziko khimicheskaya mekhanika materialov
7 Kristallografiya

The subscription to a cover-to-cover translation of a periodical may be two to five times that of the original. However, in many a case, it is the experience that the procurement of the translation of an article or a group of articles is so time consuming and costly that a library may prefer to pay a higher subscription for the cover-to-cover translation!

The situation is not bad in all cases. A few corporate bodies publish cover-to-cover traslations of Russian periodicals on a non-profit basis. The work done by the American Institute of Physics is an example. Usually, the cost of such cover-to-cover translations is relatively lower than that published by commercial organisations.

7 NATIONAL TRANSLATION CENTRE

With the increasing demand for translations from foreign languages, the whole question of translation service at the national level needs careful examination. It is desirable that a

National Translation Centre is established. In addition to making available traslations from different languages on request, the Centre should have information on the translations done in the different institutions in the country, the translations available at and through other national and international translation services. It should also dissemirate periodically information about the availability of translated documents and translation services through suitable media.

8 ACKNOWLEDGEMENT

The authot is thakful to Shri K D Sharma, Director, Central Glass and Ceramics Research Institute, for permission to contribute this paper to the DRTC Seminar(7)(1969). Thanks are also due to Dr R L Thakur for his interest and to Shri G S Basak for his assistance.

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DRTC Seminar (7)(1969). Paper KD.

TRANSLATION OF SERBO-CROATIAN SCIENTIFIC DOCUMENTS IN INDIA.

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Serbo-Croatian is one of the sixteen major languages, the documents in which Indian Scientists are interested. Data on the scientific activity and document output in Yugoslavia are presented. Availability of personnel for translation work and the provision for the training of such personnel in India are discussed and data presented. Coordination of the translation activity, assessment of need for translation, availability of periodicals -- primary and secondary and cover-to-cover translations -- and the training of personnel, are considered as important factors to be taken into account in planning translation services. The existing translation facilities are mentioned. The establishment of a national translation centre and its functions are discussed.

1 SERBO-CROATIAN LANGUAGE

Serbo-Croatian or Croat-Serbian is the language of Yugoslavia. It is spoken in the four socialist federated republics of Serbia, Croatia, Bosnia-Herzegovina, and Montenegro. Serbo-Croatian has two alphabets:

1 The Cyrillic, generally used by Serbs, Macedonians and Montenegrins; and

2 The Latin, generally used by Croats and Slovenes.

Ekavski and Ijekavski are two dialects of Serbo-

Croatian.

2 SERBO-CROATIAN RESEARCH PUBLICATIONS

21 Research Activity in Yugoslavia

The following data give some idea of the scientific activity in Yugoslavia (4, 20-22,24,25):

1 Number of scholars and research workers		8,000
2 Number of research institutions		277
21 Mathematics and other 'exact' sciences	109	
22 Biological sciences	95	
23 Social sciences	73	
3 Number of new books published		7,000
4 Number of copies of books published annually		40 millions
5 Number of periodicals (1965)		904
6 Number of papers published (1965)		1,072

7 An appreciable number of Doctorate theses and patents is notified in *Referativni bilten doktorskih discertacija* (16) and *Bibliografija jugoslovenskih patenata* (1) respectively.

22 Importance of Serbo-Croatian Documents

From the data given in the preceding section, it is obvious that there is a fairly large number of research publications in Serbo-Croatian. It has been mentioned in an earlier paper (13) that Serbo-Croatian is one of the sixteen languages the publications in which Indian scientists are interested. With the increasing technical collaboration and exchange of scholars between India and Yugoslavia such interest will increase in future.

3 PERSONNEL FOR TRANSLATION IN INDIA

31 Prior to 1966

Prior to 1966 there were very few persons who could be availed of for translation from Serbo-Croatian. These persons were of two categories.

1 Persons returning from Yugoslavia after completing some course or other assignment in that country; and

2 Persons who had training in or familiarity with a language allied to Serbo-Croatian such as Russian.

32 After 1966

In 1966, a Course in Serbo-Croatian language was started in the University of Delhi. Data about the number of persons who have taken the course are given below:

YEAR	Number of Persons			
	Certificate (1966-)		Diploma (1968-)	
	N taking Course	N Passed	N taking Course	N Passed
1966	25	13		
1967	26	13		
1968	10	3	11	6
1969	5		3	

Thus, the Delhi University courses have produced till 1968, thirty-five persons with a knowledge of Serbo-Croatian.

33 Delhi University Course

To facilitate an assessment of the suitability of the Delhi University courses in Serbo-Croatian in preparing translators in that language, information about the duration, syllabi and examinations of the courses are given in brief in Sec 331 and 332 (23).

331 Certificate Course

Duration and class.- Forenoon classes. Four lectures per week.

Syllabus.- Parts of speech. Phonetics. Morphology. Elementary Syntax.

Emphasis is placed on spoken language and translation of prose into English. Practice in working with dictionary.

Examination.- Paper I: Translation from unseen passages into English or Hindi using a dictionary.

Paper II: (1) Grammar; Practical questions. (2) Translation of English or Hindi text into Serbo-Croatian (simple sentences).

Oral: (1) Reading. (2) Phonetics. (3) Conversation. (4) Questions.

332 Diploma Course

Duration and class.- One year duration after completing Certificate Course. Four lectures per week.

Syllabus.- Grammar, with emphasis on syntax. Practice in translating Serbo-Croatian into English and vice-versa. Interpretation of spoken language and introduction to Serbo-Croatian language and literature.

Examination.- Paper I: Translation from unseen passage of average difficulty into English, using a dictionary.

Paper II: (2) Grammar. (2) Translation of English into Serbo-Croatian.

Oral: (1) Reading. (2) Phonetics. (3) Conversation. (4) Questions from the history of language and literature. (5) Questions from books read at home.

333 Advanced Diploma Course

An Advanced Diploma Course in Serbo-Croatian is proposed to start in 1970.

34 Facility for Training in Yugoslavia

Under the Programme of Exchange of Scholars between India and Yugoslavia, each year one or two scholarships are available to persons in India for study of Serbo-Croatian language in Yugoslavia. Three Indian students are at present studying Serbo-Croatian in the University of Belgrade, Belgrade. The universities in Yugoslavia giving training facilities in Serbo-Croatian language are:

1 University of Belgrade, Belgrade
2 University of Ljubljana, Ljubljana
3 University of NIS, NIS
4 University of Novi Sad, Novi Sad
5 University of Sarajevo, Sarajevo
6 University of Zagreb, Zagreb

4 FACTORS IN PLANNING TRANSLATION SERVICE

In planning an efficient and economical translation service in Serbo-Croatian language in India, the following factors, among others, should be taken into consideration.

41 Coordination of Translation Activity

Several universities, national laboratories and other research, development and production establishments have their own local translation unit and panel of translators. This is a recognition of the importance of translation from foreign languages. But the functioning of the translation units could be more effectively coordinated so that the wastage of translation potential is reduced to a minimum.

42 Assessment of Need

The potential demand in the country for translation from Serbo-Croatian should be assessed in terms of the approximate number of pages to be translated in a year, the subjects of dominant interest, etc.

43 Availability of Periodicals

There are a number of periodicals published in Yugoslavia, which carry articles of relevance to the research and developmental work done in India. A study of the union catalogue of periodicals published by Insdoc indicates that out of about 400 scientific and technical periodicals published in Yugoslavia, Indian libraries (73) receive only 29 titles. In the efficient organisation of translation work, the availability of the periodicals from which translations might be required frequently is an important consideration. A select list of the important scientific and technical periodicals of Yugoslavia that should be made available in India is given in Sec 72. These periodicals are being received by the Institut Za Naucno-Technicku Dokumentaciju i Informacije (INIDI), Belgrade (9). The articles published in these periodicals are indexed in Bibliografija jugoslavija issued by the Bibliografski Institut.

The Institute for Medical Documentation, Belgrade, is issuing Medicinskaja bibliografija since 1954. It lists selected articles from Yugoslavian periodicals in the medical and related fields. The entries are arranged according to UDC number and are printed in 102 mm x 70 mm format with the original title in brackets and English and Russian translations (10,12).

44 Personnel for Translation

A survey of the personnel avalable for translation work from Serbo-Croatian is necessary. The survey should also collect information on the basic subject background andexperience in technical translation work of the persons. The available personnel should be suitably utilized.

In 1967, Insdoc (New Delhi), published the Roster of Indian scientific and technical translators. Nearly 3,000 circulars were sent to various kinds of institutions. Wide publicity of the preparation of the Roster was also given through newspapers and periodicals. In spite of all this, only one-fifth of the number addressed responded to the questionnaire.

Of the 603 translators listed in the Roster, only one name appears under Serbo-Croatian language. The Roster could be brought up-to-date with the inclusion of the names of the persons completing the Delhi University Courses mentioned earlier.

45 Training of Personnel

The syllabus of the courses and practical work done in the courses in Serbo-Croatian should be such as to fit the candidates for efficient translation service. In making provision for training, the demand and supply position for such persons in India should be borne in mind.

46 Cover-to-Cover Trnslation

The availability of cover-to-cover translations of certain periodicals should be taken into consideration. The National Science Foundation, USA, entered into a contract with Yugoslavia in 1960 for the translation and publication of Yugoslavian scientific articles and patents. Under this scheme, nine current periodicals are being translated from Serbo-Croatian into English (8). Information on these periodicals is given in Sec 73.

The cost of a cover-to-cover translation of a periodical is high compared to the subscription cost of the original periodical. Our research establishments should pool their resources together and the library of each establishment may subscribe to such of the periodicals in cover-to-cover translation that are likely to be of frequent use by its readers. A system of interlibrary loan and exchange of periodicals can then meet most of the requirements of all the institutions with respect to the cover-to-cover translations.

5 MANAGEMENT OF TRANSLATION SERVICE

51 Existing Translation Facility

Translation from Serbo-Croatian is at present largely done by the following institutions:

1 Insdoc, New Delhi; 3 Desidoc, New Delhi; and
2 Iaslic, Calcutta; 4 Bhabha Atomic Research Centre, Bombay

These institutions do not, however, have a full time translator for Serbo-Croatian. Insdoc and Iaslic make use of the persons in their Panel of Translators, in providing translation service for the whole country. In 1966 and 1967, Iaslic translated one document of 2,909 words and 2 documents of 5,021 words respectively (7).

52 Bibliographical Control

Bibliographical control of translations from Serbo-Croatian language produced in India and obtained from outside would include their location, collection, preservation, classification, cataloguing, and utilisation (15).

53 National Translation Centre

A National Translation Centre to coordinate, effectively organise and promote bibliographical control of the translation work done in India is very desirable. A national institution already functioning on similar lines could be supported to take up such work. The functions of the National Translation Centre would include the following:

1 Provide translation service in all the languages according to demand.

2 Maintain a copy of each of the translations done by it and also copies of translations sent to it from different institutions in the country.

Annotation.- It is to be considered whether a copy ofeach translaion done in the different institutions in the country should be deposited with the national centre. Perhaps, it is sufficient if the Centre maintains a union catalogue of the translations as an aid in inter-library loan of the translations. After locating the copy of a translation, the library possessing it may directly supply the library requesting for it, a reprograph or other copy.

3 Classify and catalogue the collection.

4 Disseminate information about the items in the collection,those added to it from time to time, and those translations done in other libraries in the country, through the publication of a periodical list or other suitable means.

5 Provide access to thetranslated documents by making reprograph copy whenever there is a demand.

6 Maintain an up-to-date directory of translators and translation facilities in the country.

7 Make periodical survey of the demand for translations from different languages and in different subject fields; and the personnel available for translation work drom different languages and in different subject fields.

8 Promote and advise on the training of personnel for translation work.

9 Maintain close liaison with the important national and international centres for the biblio-

graphical control of translations, such as the following:

1 Commonwealth Index of Scientific Translations, Aslib, London.

2 European Translation Centre, Delft, Holland.

3 Transatom, Brussels, Belgium.

4 Canadian Index of Scientific Translations, National Science Library, Ottawa.

5 Special Libraries Association's Translation Centre, Chicago, USA (14).

10 Collaborate with and provide information about the translated documents produced in other countries through publications such as the following:

1 Index translatonium (6)

2 World Index of Scientific translations (5)

3 Transatom bulletin (18)

4 Translations register index (19)

5 US Government research and development reports (USGRDR) (17)

6 Bibliography of medical translations (3)

7 Bibliographies of PL 480 translations (for Russian, Polish, and Serbo-Croatian scientific material) (2); and

8 NLL translation bulletin (11).

6 ACKNOWLEDGEMENT

I am grateful to Dr Ileana Cura of Belgrade University for her advice. I am thankful to Shri N P Rao, Officer-in-Charge, Desidoc, and Dr Kartar Singh, Director, Defence Science Laboratory, for their keen interest and for permission to contribute this paper to the DRTC Seminar (7)(1969). Thanks

are also due to my colleagues Shri G P Sharma and Shri N K Rampal, for their secretarial assistance.

7 APPENDIX

71 Table 1. Book Production in Yugoslavia

SN	Year	Number of Books Produced in					
		Generalia	Natural Sciences	Humanities	Social sciences	Unspecified	Total
1	1957	173	1,701	1,850	1,868	176	5,768
2	1958	172	1,449	1,772	1,787	96	5,276
3	1959	139	1,239	1,878	1,737	67	5,060
4	1960	121	1,276	1,956	1,865	117	5,335
5	1969	240	1,064	1,964	2,226	-	5,531
6	1962	230	1,154	2,409	1,844	-	5,637
7	1963	121	1,780	2,837	1,553	109	6,400
8	1964	263	1,389	3,749	3,248	-	8,019
9	1965	255	1,295	3,182	3,248	-	7,980
10	1966	283	1,202	3,445	2,588	-	7,768

72 Table 2. Selected Scientific and Technical Periodicals in Serbo-Croatian Language

Note.- Periodicals already available in India are marked with an aesterisk.

SN	Title
1	ARHITEKTURA URBANIZAM. Organ saveza arhitekata Jugoslavije i Urbanistickog saveza Jugoslavije

SN	Title
2	ARHIV ZA HIGHIJENU RADA I TOKSIKOLOGIJU
3	ARHIV ZA TEHNOLOGIJU (TECHNILOGICA ACTA)
4	**AUTOMATIKA**. Jugoslovenski strucni casopis za automatiku, Ljubljana.
5	BIBLIOGRAFIJA JUGOSLAVIJE - knjige, brosure i muzikalije - Jugoslovenski bibliografski institut.
6	BIBLIOGRAFIJA JUGOSLOVENSKE PERIODIKE. Jugoslovenski bibliografski institut.
7	BIBLIOTEKAR. Organ Drustva bibliotekara Srbije.
8	CESTE I MOSTOVI
9	CIVILNA ODBRANA
10	CIVILNA ZASTITA
11	CROATICA CHEMICA ACTA. Hrvatsko kemjsko drustvo, Zagreb.
12	KODUMENTACIJA ZA GRADJEVINARSTVO I ARHITEKTURU. Jugoslovenski gradjevinski centar.
13	DRAVNA INDUSTRIJA.
14	ELEKTROTEHNICKI VJESNIK
*15	GLASNIK HEMIJSKOG DRUSTVA.
*16	GLASNIK MATEMATIGKO FIZICKI I ASTRONOMSKI.
17	GRADJEVINAR. Savez gradjevinskih inzenjera i technicara SR Hrvatske.
18	JUGOSLOVENSKO PRONALAZASTVO. Organ Saveza pronalazaca i autora tehnickih unapredjenja Jugoslavije.
19	KEMIJA U INDUSTRIJI. Casopis kemicara i tehnologa Jugoslvije.

SN	Title
20	KOZA I OBU-CA.
21	MASINSKO TEHNICKI GLASNIK
22	MATEMATICKI GLASNIK. Vesnik Drustva matematicara i fizicara.
23	MATERIJALI I KONSTRUKCIJE. Casopis za istrazivanja u oblasti materijala i konstrukcija.
24	MORNARICKI GLASNIK
25	NAFTA. Institut za naftu, Zagreb.
*26	NAUCNO TEHNICKI PREGLED
27	ORGANIZACIJA RADA
28	PATENTNI GLASNIK. Sluzbeni list Uprave za patente.
29	PRONALAZASTVO. Organ Savezne Uprave za pronalazastvo.
30	STANDARDIZACIJA. Jugoslovenski zavod za standardizaciju, Beograd.
31	SVEUCILISNI VJESNIK. Jugoslovenska akademija znanosti i umjetnosti, Zagreb.
32	TEHNIKA. Organ Saveza inzenjera i tehnicara Jugoslavije.
33	TELEKOMUNIKACIJE. Zajednica, JPTT, Beograd
34	VAZDUHOPLOVNI GLASNIK.
35	VOJNO DELO
36	VOJNOSANITETSKI PREGLED
37	VOJNOTEHNICKI BILTEN.
38	VOJNOTEHNICKI GLASNIK.
*39	ZASTITA MATERIJALA. Casopis za probleme zastite materijala, postrojenja i objekata. Beograd.
40	ZAVARIVAC.
41	ZAVARIVANJE. Bilten Drustva za tehniku zavarivanja Hrvatske.

73 Table 3. Periodicals Translated Cover-to-Cover from Serbo-Croatian into English

SN	Title of the Periodical in Serbo-Croatian	Title of the Periodical in English	Translation begins with		Available from
			V	Year	
1	Acta Medica Jugoslavica, Beograd.	Acta Medica Jugoslavica	16	1962	Clearing House for Scient and Technical Information, Port Royal and Braddock Roads, Springfield, Virginia. (US). Copies sold individually
2	Arhiv Bicloskih Nauka, Beograd.	Journal for Biblogical Research	14	1962	- do -
3	Arhiv Za Poljoprivredne Nauke (i Tehniku), Beograd.	Journal for Scientific Agricultural Research	15	1962	- do -
4	Institut Za Nuklearne Nauke 'Boris Kidric' Bilten, Beograd.	Bulletin of the Boris Kidric Institute of Nuclear Science.	13	1962	- do -

SN	Title of the Periodical in Serbo-Croatian	Title of the periodical in English	Translation begins with		Available from
			V	Year	
5	Institut Za Vodoprivredu 'Jaroslava Cerni', Saopstenja.	Works of the Hydrotechnical Institute (Eng. Jaroslav Cerni)	9	1962*	Clearing House for Federal Scient and Tech Information, Port Royal and Braddock Road, Springfield. (US). Copies sold individually
6	Lijecnicki Vijesnik, Zagreb.	Medical Journal	84	1961	- do -
7	Rudarsko-Metalurski Zbornik Ljubljana.	Mining and Metallurgy Quarterly	1	1961	- do -
8	Srpsko Hemisko Drusto, Beograd, Glasnik.	Bulletin of the Chemical Society.	27	1961	- do -
9	Vesnik Zavoda Za Geloska i Geofizicka Istrazivanja	Review of the Geological and Geophysical Institute		1962	- do -

* Begins with N 22.

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8	Sec 46	INDIAN NATIONAL SCIENTIFIC DOCUMENTATION CENTRE. (New Delhi). Seminar on technical and scientific translations (15 to 17 April 1965). 1965. Sec A51.
9	Sec 43	INSTITUT ZA NAUCNO-TEHNICKU DOKUMENTACIJU INFORMACIJE. Katalog casopisa i dopuna. Katalog casopisa. 1966.
10	Sec 43	INTERNATIONAL FEDERATION FOR DOCUMENTATION. Abstracting services in science, technology, medicine, agriculture, social sciences, humanities. 1965.
11	Sec 53(10)	LLU TRANSLATIONS bulletin. (Aslib proc. 13;1961;59).
12	Sec 43	MEDICINSKAJA BIBLIOGRAFIJA. (Bibliog doc termin. 7;1967;43).
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19	Sec 53(10)	TRANSLATIONS REGISTER index. (Doc abstr. 2;1967;147).
20	Sec 21	ULRICH'S INTERNATIONAL periodicals directory. Ed 11. 1965.
21	Sec 21	UNESCO. Scientific and technical translating and other aspects of the language problem. Ed 2. 1958. P 17.
22	Sec 21	UNITED NATIONS. Statistical yearbook. 1958. 1961. 1964. 1967.
23	Sec 33	UNIVERSITY OF DELHI. Handbook of information: Department of Modern European Languages. 1967-8.
24	Sec 21	WORLD LIST of scientific periodicals published in the years 1900-1960. Ed 4. 1963-5.
25	Sec 21	YUGOSLAVIA, FEDERAL SCRETARIAT FOR INFORMATION. Facts about yugoslavia. 1966.

PART L: DRTC RESEARCH CELL : REPORT FOR 1969

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CLASSIFICATION RESEARCH.

(DRTC Research Cell, report (1969). 1).

M A GOPINATH, Lecturer, Documentation Research and Training Centre, Bangalore 3.

1 INTRODUCTION

This is a technical report of the classification research done by the members of the DRTC Research Cell in 1969. Sec 21 to 26 contain a report of the work with respect to an understanding of the structure and development of the universe of subjects. Sec 31 to 33 contain a report of the work done in the idea plane. The result of this work is applicable to all schemes for classification. Sec 4 refers to the work done in the notational plane in Colon Classification. Sec 5 gives a list of the new Colon Classification schedules. Sec 6 refers to the preview of CC, ed 7 (1971). Sec 71 to 74 contain a report on the work done on the feasibility and modification needed in the Colon Classification schedule for use in a computer-aided document finding system.

2 UNIVERSE OF SUBJECTS

The importance of an understanding of the structure and development of the universe of subjects on the part of the classificationist and of the classifier is stressed in five papers presented in this volume.

21 Specialists' View of the Universe of Subjects

In Paper AA, F J Devadason describes the specialist's view of certain aspects of the structure and development of the universe of subjects (3). According to a biologist, analogies of the biological phenomena such as fragmentation, hybridisation, and integration of fragments, may be found in the structure and development of the universe of subjects. The kinds of new subjects resulting from the interaction of some traditionally compartmentalised subjects are also described from the specialist's points of view.

22 Structure and Development of Subjects going with Public Health

In 1968, the subject "Public Health" was raised to the status of Main Subject, and included in the schedule of Main Subjects in CC. Till then it was dealt with as a compound subject going with the Main Subject Medicine.

In Paper AB, R Ahuja (1), traces the stages of development of the subject Public Health, from the first century BC to the twentieth century AD. The content and emphasis in subjects going with Public Health have varied at different stages of its development. The data on the number of significant contributions indicate that "Bacteriology, immunology, and epidemiology" have more than 50 per cent of the total contributions. About 75 per cent of the total significant contributions has come up during the last one century. The subjects falling in the fields of Clinical Medicine, Preventive Medicine, and Social Medicine are among the major areas of interest to the specialist in Public Health. All these developments amply justify taking "Public Health" as a main

Subject. The need for recognition of certain Specials Basic Subjects with Public Health as the Host Main Subject in each case has been pointed out, with illustrative examples. Penumbral subjects such as Medical Sociology, Human Ecology, Social Anthropology, Social Psychology, Social Paeditrics, Social Geriatrics, and Social Pathology are mentioned.

23 Structure and Development of Psychology

In Paper AC, M P Sinha describes the structure and development of the subjects going with the Main Subject Psychology (21). Psychology is essentially the study of behaviour of an individual person. By the very nature of the subject, the various theories of psychology are capable of interacting with the Social Sciences such as Education, Economics, and Sociology. These interactions naturally give rise to many "Hybrid Subjects". A chart illustrates such developments. After describing the status of the Subject "Psychology" in the different well-known schemes for classification, Sinha explains that the treatment of Psychology in CC even from ed 1 onwards, appears to be in conformity with the development of the subject Psychology itself. It is pointed out that the classification of the systems and sub-systems of Psychology gives rise to certain problems.

24 Spiral of Scientific Method

In Paper AD, Revannasiddappa shows that the Spiral of Scientific Method (20) can be used to describe helpfully the stages of developments in a subject. The stages of developments in the formulation of the Law of Conservation of Mass-Energy, the apparent crisis that had occurred in the application of the Law of Conservation of Energy in the field of Radioactivity, and the role of the Special Theory of Relativity in resolving the crisis, are described. Certain inferences are drawn about the structure and development of the subjects in the field of Physics.

25 Analysis of Subjects

In Paper EA, Gopinath and Jayarajan (4) attempt to draw inferences about the structure and developments of an assortment of compound and complex subjects going with the Main Subject Medicine. For this purpose, books were selected from the English catalogue (1925) and the British national bibliography (1951 and 1967). The analysis was made with the aid of the Postulates and Principles formulated by Ranganathan. It was found that two-faceted subjects had maximum number of books in 1925, where as in 1951 and 1967, the 3 and 4 faceted subjects had maximum number of books. Further, there were a large number of subjects with greater intension published in later years than those published during a generation or two earlier.

26 **Analysis** of Subjects in Reader's Query

Neelameghan analysed a set of subjects presented in the 323 questions in the fields of High-speed Aerodynamics and Aeronautical Engineering (5). Facet Analysis of these subjects were based on Postulates and Principles formulated by Ranganathan. The subjects in queries were patterned into 34 facet structures. About 73 per cent of these were based on three similar facet structures with 3, 4, and 5 facets respectively. The maximum number of facets in any one subject was 12 and the minimum 2, with an average of 5.4. The average number of Kernel Ideas in a subject was found to be 8. This is in conformity with the findings of psychology of the Span of Immediate Memory and the Span of Absolute Judgment. The average frequency of incidence of (P), (M) and (E) isolates was in the ratio 4.2:5.6:1. Among Complex Subjects, the Influence Phase Relation had the highest incidence.

3 IDEA PLANE

31 Relation Between Two Subjects

The universe of subjects embodied in documents presents subjects involving relations between two different subjects. It may be facet relation or phase relation. An examination of an assorted number of documents has been made in Paper BB by Neelameghan and Gopinath (14). The analysis led to a re-examination of the sequence of Bias Phase and Biasing Phase. It also led to a recognition of certain kinds of isolate ideas such as "Basis", "Interpretation" and "Method". This recognition has led to viewing some of the subjects hitherto considered to represent Phase Relation as Facet Relation. Further, the paper has posed the question "Is Psychosomatic Medicine a phase relation, or facet relation or a Basic Subject?"

32 Differentiation of Energy Isolate from Property Isolate

In 1966, an examination of all the isolates enumerated in the different schedules under the heading "Foci [E] cum [2P]" in the *Colon classification* (Ed 6;1963) was started (12). Most of the isolates enumerated in these scheduleswere taken to be Property Isolates and deemed to be a manifestation of the Fundamental Category Matter. However,some of the isolates posed problems in identifying their manifestation. Most of these are action-associated isolates. The differentiation of Energy Isolate from the Property Isolate has been a problem. In Paper BC to this Seminar, Neelameghan (8) suggests that the action-associated isolates may be grouped as an

1 Action-associated Isolate Idea occurring as an attribute (but not qualifier) of one or other of the isolate ideas or with the Basic Subject and occurring in one and the same compound subject.

2 Action-associated Isolate Idea occurring not as an attribute of any other isolate idea when either of them occurs in one and the same Compound Subject.

Each one of the isolates belonging to Group 1 may be deemedto be a manifestation of the Fundamental Category Matter and that belonging to Group 2 may be deemed to be a manifestation of the Fundamental Category "Energy".

33 Facet Sequence in CC

The concept of "Property" taken as Matter-Property Isolate leads to difficulties in facet sequence of certain subjects. Neelameghan and Gopinath have given illustrative examples to show that the sequence of facets presented by certain Compound Subjects when analysed according to the

Postulates gives a sequence which does not conform to the implication of the Wall-Picture Principle, although the sequence is in conformity with the Postulates for Sequence (13). The problem is traced to taking Property as an isolate. The sequence of facets of the Compound Subjects could be made to satisfy the Postulates for Sequence of Facets as well as the Wall-Picture Principle, if we deem "Property" not to be an Isolate Idea but only a Kernel Idea. Such a Kernel Idea can be attached to any Isolate Idea as determined by the Wall-Picture Principle. This idea is, however, to be experimented upon with a large number of examples from different subjects.

4 DEVELOPMENT OF THE USE OF DIGITS IN CC

A study of the development of the use of digits in CC from 1924 to 1968 was made by Ranganathan (18). This study indicated clearly the policy of the use of different species of digits in CC and the introduction of new digits whenever needed, with due respect to the implication of the Law of Parsimony. It also highlighted that the notational system of CC has resilience and capacity to implement the developments in the universe of subjects, in conformity with the decisions made in the idea plane. The study also listed a set of digits likely to be used in CC Ed 7. However, there is one deviation. Instead of ↑ (upward arrow), the use of " (double inverted comma) has been preferred to indicate Anteriorising Quality as suggested in Paper BK to DRTC Seminar (6)(1968).

5 SCHEDULES CONSTRUCTED

51 Schedule of Main Subjects

During 1969, Ranganathan revised the schedule of Main Subjects (17) and Partial Comprehensions. This schedule contained 82 Main Subjects: 41 of these are traditional Main Subjects, 16 Distilled Main Subjects, (of which 4 are old Main Subjects), 10 Fused Main Subjects, and 19 other new Main Subjects. There are 23 Partial Comprehensions of which 18 are new ones. Out of these, only 29 Main Subject Numbers and only 5 Partial Comprehension Numbers need correction.

52 Design of Depth Schedules

During 1969, CC depth schedules have been constructed by the DRTC Trainees (1968-69) for the following subjects.

SN	Author	Depth classification for
1	A H Kidwai	2;51 Library Classification
2	Harjit Singh	BT93 Statistical Quality Control
3	Jacob T Thomas	D8,9E38 Production of Air Compressor
4	G S Raghavendra Rao	D8,9M13 Production of Electrical Generator
5	(All trainees cooperatively)	D8,9K65 Production of Incandescent lamp
6	S G Mahajan	T;3 Teaching Technique

The schedules are tentative and are unpublished.

53 Step-by-Step Procedure

Neelameghan, in a series of five papers (6,7, 9,10,11)gave a revised step-by-step procedure for the design of depth classification schedules, with illustrations. Further articles in the series are expected.

6 PRE-VIEW OF COLON CLASSIFICATION ED 7 (1971)

Ranganathan has given a comprehensive preview of the forthcoming ed 7 of CC (16). The preview gives a background study about the need for designing a scheme for classification on the basis of a sound and dynamic theory of library classification. The preview gives the proposed changes in Ed 7 and also gives a routine for correction of Class Number, based on the Law of Osmosis (19).

7 COMPATIBILITY OF CC AND UDC

In a paper presented to the Thirty-ninth International Conference on Information, held at Rome in September 1969, Ranganathan and Neelameghan (20) discussed the possibility of five types of compatibility studies between document finding systems. They are:

1 Any two electronic systems;

2 Any two catalogue systems;

3 Any catalogue system and any electronic system;

4 The classificatory language used in any catalogue system and the machine language of any electronic system; and as the ultimate basis of all these,

5 Any two schemes for classification.

As a case study, compatibility of the two schemes for classification namely Colon Classification and Universal Decimal Classification is discussed. The compatibility in respect of

1 Theory of classification;

2 Its application in-action in CC as well as UDC ; and

3 The efficiency of CC and UDC for use in an electronic document finding system,
have been discussed.

8 CLASSIFICATION AND COMPUTER-AIDED FINDING

81 A Survey of the Trend

In a survey, G Bhattacharyya (2) examines the role of depth classification in a system for document finding. The survey covers some significant works of the period 1945-1968. It highlights Vannevar Bush's prophecy about "Memex" and gives a series of attempts at using different specialists schemes for classification in Gremas (1955), Powersamas (1958), and Leslie and Scheele efforts in 1961 and 1962 respectively. The survey gives a brief description on the project "Metereological Literature using UDC" and also of the seven reports in the project on "Evaluation of UDC as Indexing Language for mechanised reference retrieval system", since 1965. In conclusion, Bhattacharyya suggests that a harmonious combination of the potentiality of the New Methodology for the design of depth classification developed in the DRTC with the ability of a computer for fast search in the design of a system for Document Finding, to meet more efficiently the document needs of specialists.

82 Formulation of Kernel Terms for a Subject and of Isolate Terms

Neelameghan and Venkataraman compare the procedure for the synthesis of Class Number by the conventional method with the one using a general purpose computer (15). They suggested a modified Postulational Method for the formulation of kernel terms. The problem of homonyms in kernel terms denoting subjects is considered and methods of resolving them are suggested so as to achieve one-one correspondence between the kernel terms and the subject. This is an absolute necessity in the synthesising numbers into a Class Number by a computer.

83 Schedule-on-Tape

Venkataraman and Neelameghan describe (23) the procedure and give flow-charts for the operation of a general-purpose computer for the transfer on to magnetic tape a schedule of Basic Subjects, schedules of special isolates for subjects going with different Basic Subjects, and schedules of Common Isolates of different kinds. Techniques have been devised to identify a specific schedule.

84 Formation of Isolate Number by Computer and Devices in CC

Venkataraman and Neelameghan describe (24) step-by-step procedure for the formulation of Isolate Number, using a general purpose computer

1 According to the rules of CC for Alphabetical Device, Numerical Device, Environment Device, Geographical Device, and Chronological Device; and

2 For an isolate deemed to be a manifestation of the fundamental category either of Space or of Time.

The study also covers the method of assembling of the Basic Subject Number and the Isolate Numbers to form Class Number retaining the helpful sequence of the isolate ideas arrived at in the idea plane. Flow-charts of the computer operations have also been worked out.

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CATALOGUING RESEARCH.

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1 INTRODUCTION

This is a technical report of the research in cataloguing done by the members of the DRTC Research Cell in 1969. Each of the following sections contains successively a report of the following subjects:

1 Review of the research work in cataloguing done in India;

2 Formulation of the Canon of Recall Value -- a new canon added to the list of the Normative Principles of Cataloguing;

3 Critical and comparative study of the different editions of CCC and AACR; and

4 Work done on Postulate Based Subject Headings.

2 CATALOGUING RESEARCH IN INDIA

21 Research Project of June, 1969

Research in cataloguing may be said to have begun in the last quarter of the eighteenth century. In India it was first started by S R Ranganathan in 1925. It took a new turn in 1928 with the formulation of the Five Laws of Library Science by him. To get a comprehensive idea of the research work done in India on the various facets of cataloguing, a research project was taken up in June 1969. The project aimed at

1 Tracing the background against which cataloguing research was first started in India;

2 Examining the nature of the cataloguing research deemed to be the background of the work in India;

3 Making a survey of the research work done on cataloguing in India;

4 Reviewing each piece of work to understand its significance as a contribution to the field of cataloguing;

5 Making a comparative study of the cataloguing research done outside India and in India; and

6 Marking the areas in cataloguing calling for further research.

22 Findings

The findings of this research project have been published (1). The findings are summarised in the following sections.

23 Background of Pragmatic Research in Cataloguing

It is helpful to regard the last quarter of the eighteenth century as the beginning of the modern period of cataloguing. Prior to 1928, the chief contributors to the field of modern cataloguing were:

1 Henry Barber;
2 Antonio Genesio Mario Panizzi;
3 Charles C Jewett;
4 Andrea Crestadoro;
5 Karl Dziatsko;
6 Charles A Cutter;
7 K A Linderfelt; and
8 J Kaiser.

However, they had no fundamental laws of library science or normative principles of cataloguing to guide their work. Therefore, their research was hardly of the a priori variety. It had to be mostly pragmatic and developmental. This pragmatic research was observational as well as empirical. The developmental research took over from the pragmatic research and made finer adjustments and improvements on the results already obtained, to faclitate immediate use.

24 Basis for A Priori Research

In 1928, S R Ranganathan enunciated the Five Laws of Library Science. They provided the basis for deep a priori research in the different branches of library science including cataloguing. Thus research in cataloguing in India began as a priori. It was first carried out by S R Ranganathan himself. It took a positive turn in 1938, by his formulation of Normative Principles, special to cataloguing theory and practice.

25 Ranganathan's Initial Research

Ranganathan's research in cataloguing has always been a blending of pragmatic research -- that is, observational research and empirical research -- and of a priori research based on the Five Laws and the Normative Principles of Cataloguing. The result of his initial researches were embodied in the following works:

1 Classified catalogue code (1934);
2 Theory of library catalogue (1938);
3 Dictionary catalogue code (1945); and
4 Library catalogue: fundamentals and procedure (1950).

26 Developmental Research Since 1950

The work of Ranganathan upto 1950 was followed by a considerable amount of developmental research on the subject. It took over mostly from a priori research and made finer adjustments and improvements in the results already obtained to facilitate the achievement of immediate utility. In this developmental research, besides Ranganathan, an appreciable number of contributions have been made by the members of the Library Research Circle (Delhi). Research in cataloguing in India was taken to a further stage by the recognition and explicit statement of the steps in Scientific Method.

27 Significant Contributions of India

India's research in cataloguing has made significant contributions in the different areas of cataloguing. A few of these areas are as follows:

1 Cataloguing Terminology;

2 Normative Principles of Cataloguing;

3 Layout of a Catalogue Code;

4 Alphabetisation;

5 Critical and comparative study of different Catalogue Codes;

6 Name-of-Person Heading;

7 Corporate Heading;

8 Subject Heading;

9 Uniform Cataloguing at International level;

10 Cataloguing of Future Books and the Author Statement for a Book on its Title-page; and

11 Cataloguing of Periodical Publications.

28 Potentialities of the Canons of Cataloguing

The set of Canons of Cataloguing is one of the outstanding contributions of India in the field of cataloguing. The potentiality of these Canons have not yet been fully exploited by the library profession.

3 CANON OF RECALL VALUE

31 Sensing the Problem

A critical and comparative study of the different editions of the Classified catalogue code and of the Anglo-American Cataloguing Rules is one of the long-term research projects engaging the attention of the DRTC Research Cell. In this connection, while examining the rendering of multiworded names of different kinds in the Headings of Main Entries, Ranganathan sensed that the puriew of the Canon of Prepotence and that of the Canon of Sought Heading were too extensive to guide directly the rendering of such names. This made him rethink about these Canons.

32 Concept of Recall Value

The structure of the multi-worded names-of-

1 Person;
2 Government;
3 Organ-of-Government;
4 Institution;
5 Organ-of-Institution;
6 Conference;
7 Organ-of-Conference;
8 Series; and of the multi-worded
9 Titles,

were analysed.The nature of each word constituting a multiworded name was examined. It was found that in re-calling to memory a multiworded name once known, each of the words constituting the name, does not not possess equal value. This quality of being called back of a word constituting a multiworded name has been named 'Recall Value'.

33 Application in Determining the Entry Word

The concept of Recall Value was applied in determining the Entry Word of a multiworded name. It was found that in the case of a multiworded name-of-person, the indication of Recall Value totally agrees with the suggestion of the Canon of Prepotence taken along with the Principle of Probability. On the other hand, the Canon of Prepotence and the Canon of Sought Heading were not found sufficient to determine the Entry Word in a multi-worded name of

1 An Organ-of-Government;
2 An Institution,
3 An Organ-of-Institution;
4 A Conference;
5 An Organ-of-Conference; and in a multiworded
6 Title.

The practice of using the first substantive word in the name of a corporate body, and in a title does not respect the indication of Recall Value. For, in most cases, it happens to be the name of a subject or of some other speciality that has the highest Recall Value.

34 Recall Value and Catalogue Codes

An examination of the rules of the different catalogue codes relating to the rendering of multi-worded names in the Headings of Main Entries indicated that

1 Al the codes have respected the indication of Recall Value in respect of name-of-person.

2 The Classified catalogue code has respected the indication of Recall Value fully in respect of a name-of-organ of a Corporate Body and partially in respect of Titles. On the other hand, it has not respected this indication in respect of a name-of-institution and a name-of-conference.

3 The Prussian instructions has respected the indication of Recall Value in respect of a Title-Heading by introducing the concept of "Real Title".

4 The Anglo-American cataloguing rules has not respected the indication of Recall Value in respect of name-of-corporate-body and title.

It has been suggested that all the catalogue codes should respect the indication of Recall Value fully in formulating their rules for the choice of the Entry Word of a multi-worded name of a corporate body and of a multiworded title to be used as the Heading of the Main Entry.

35 ~~Formulation of the~~ Canon

The Canon of Recall Value has been added to the list of Normative Principles of Cataloguing. It has been enunciated as follows:

Canon of Recall Value.- The principle that in a multiworded name of

1 A Person;
2 An Institution;
3 A Conference;
4 An Organ of
  41 Government, or of an
  42 Institution, or of a
  43 Conference, and in a multiworded
5 Title of a document other than a periodical publication,

the Entry Word or the Entry Word-Group in the Heading of the Main Entry should be the one with the highest Recall Value.

A paper embodying the findings given in Sec 3 above has been published (3).

4 COMPARISON OF CCC AND AACR

The comparative study of the different editions of the Classified catalogue code (=CCC) and those of the Anglo-American cataloguing rules (=AACR) was continued. In 1969, the study covered the determination of authorship in the case of a conflict centring round

1 Person vs Person; and
2 Person vs Corporate Body.

41 Conflict of Authorship: Person vs Person

In their comparative study on the determination of authorship in the case of a conflict centring round Person vs Person (6), Ranganathan and Bhattacharyya referred to the importance of the definition of the term 'Personal Author' in resolving such a conflict. The various ways in which the conflict of authorship centring round person vs person arises have been indicated. The comparative study examined how CCC (1964) and AACR (1967) resolve such conflicts in respect of the following types of work:

1 Spoken words;
2 Correspondence;
3 Map and Atlas; and
4 Dependent work.

It has been pointed out that

1 CCC (1964) resolves the conflict as a preliminary measure before formulating the rules for the choice of Heading of the Main Entry; but

2 AACR (1967) deliberately mixes up the two problems in the rules for the choice of Heading of the Main Entry violating the Principle of Unity of Idea in formulating the rules.

42 Conflict of Authorship: Person vs Corporate Body

In their comparative study on the determination of authorship in the case of a conflict centring round Person vs Corporate Body (5), Ranganathan and Bhattacharyya have referred to the importance of stating the Normative Principles of Cataloguing in a Catalogue Code. The attempt by AACR (1967) in this direction has been pointed out. The AACR (1967) has followed the lead of CCC in the matter of respecting the Principle of Unity of Idea by separating out the rules for the choice of Heading from those for rendering it. Its deliberate mixing up in one and the same rule the resolution of the conflict of authorship and the choice of Heading has been criticised. The following cases have been considered for the comparative study of how the different editions of CCC and AACR resolve the conflicts of authorship centring round Person vs Corporate Body:

1 Documents to be deemed to be of Corporate Authorship;

2 Documents to be deemed to be of Personal Authorship;

3 Non-governmental edition of an act; and

4 Conference documents.

5 SUBJECT HEADING

In 1969, the research on "Subject Heading" by the DRTC Research Cell has mostly turned on exploiting the potentiality of the Postulates of Facet Analysis taken along with the Principles for Facet Sequence in the matter of determining coextensive multiple Specific Subject Headings. Specifically, work has been done in the following areas:

1 The potentiality of the postdetermination of Subject Headings based on Postulates in the context of the growing Universe of Subjects; and

2 The potentiality of the Forward Rendering of Subject Headings based on Postulates in the context of a Dictionary Catalogue System.

51 Post-Determination of Subject Heading

In his work on the potentiality of the post-determination of Subject Headings (4) Ranganathan has discussed the difficulties of pre-determined Subject Headings with respect to their use, preparation, and maintenance using LC Subject headings as the type. To meet the challenges thrown forth by the growing Universe of Subjects, the inadequate and rigid pre-determined list of Subject Headings should be replaced by the post-determination of the Subject Headings of subjects as and when they turn up. The first five steps in the systematic procedure of subject analysis, based on the Postulates of Facet Analysis and the Principles for Facet Sequence, are equally helpful for the post-determination of Class Numbers and of Subject Headings. Illustrative examples have been given to show the

1 Near-concurrence to this idea found in the British national bibliography;

2 Partial concurrence to this idea found in the Medical subject headings; and

3 Divergence from this idea found in the LC Subject headings.

Ranganathan has discussed in detail the problems awaiting pursuit in the improvement of the post-determination of Subject Headings in respect of the syntax of the ideas in the Forward Multiple Subject Headings and in the Reverse Multiple Subject Headings used for See Reference. The DRTC experiment in the possibility of removing the residual difficulties by using the Indicator Digits used by the Colon Classification has also been mentioned. The issue of the relative helpfulness, in document finding systems, of the use of natural language and of classificatory language respectively for expressing multiple Subject Headings has been raised.

52 Forward Rendering and Dictionary Catalogue System

In their work on the potentiality of the Forward Rendering of Subject Headings in the context of a Dictionary Catalogue System (2) Bhattacharyya and Neelameghan have noted that in the Classified Catalogue System (=CCS),

1 The Specific Entries for the subjects going with the different Basic Subjects; and

2 The Specific Entries for the Compound Subjects going with one and the same Basic Subject

are brought together and arranged in a filiatory sequence. They have demonstrated that all the features of the CCS, excepting the filiatory sequence can be incorporated in the Dictionary Catalogue System by

1 Making its subject cataloguing base on the Postulates of Facet Analysis and the Principles of Facet Sequence; and

2 Adopting the Forward Rendering Method for preparing the Specifc Subject Headings determined on the basis of the Title-in-Standrd-Terms arrived at in Step 5 of the Method of Postulates.

A General Subject Entry prepared on the basis of the Specific Subject Entry by using each of the Sought Terms in it as the First Heading followed by the other terms in it, as in a cyclic permutation, provides access to the Specific Subject Entry by any Sought Term occurring in the Specific Subject Heading. To help in determining the correct Specific Subject Heading from the Heading of a General Subject Entry itself, and to obviate the need of mentioning the Referred-to-Heading, they have suggested the use of a virgule (/) and a full stop (.) to indicate the beginning and the end respectively of the Specific Subject Heading.

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1 INTRODUCTION

This is a report of the studies in librametry done by members of the DRTC Research Cell in 1969. Sec 2 mentions the helpfulness of a statistical outlook and awareness on the part of librarians. Sec 3 reports on the scope of librametry as ilustrated by S R Ranganathan. Sec 4 to 8 reports on a few librametric studies done recently.

2 STATISTICAL OUTLOOK AND AWARENESS

A statistical outlook and a statistical awareness on the part of the librarian would help him understanding better some of the aspects of library work. With this in mind, in addition to giving a statistical flavour wherever possible, in the exposition in the teaching, the diferent subjects of the documentation course, a series of about twenty lectures on elements of statistical Calculus, Operations Research, and Sampling were arranged during June-August 1969. Shri V V Buche of the SQC Unit, ISI, Bangalore, who conducted the classes, demonstrated the application of many of the techniques to library situations. The students were also given a few assignments.

3 SCOPE OF LIBRAMETRY

The term 'Librametry' was coined in 1948 by S R Ranganathan, at th Aslib Conference in Leamington Spa. In Paper DA contributed to this Seminar, Ranganathan (6) has given illustrative examples of the application of Statistical Calculus, Operations Research, and Sampling to certain library problems. The examples include the following:

Statistical method in the

1 Determination of the strength of library staff;

2 Disposition of library staff for circulation work during different library hours;

3 Disposition of library staff for reference service during different library hours;

4 Organisation of library system;

5 Establishing the distinction between "service library" and "dormitory library";

6 Design of library building, fittings and furniture;

7 Book selection;

8 Absolute Syntax and Facet Syntax in relation to classification;

9 Length of Class Number;

10 Variation in style in writing catalogue entries; and

11 Doc-Finder.

Operations Research in the

1 Transfer of a big library from one building to another; and

2 Periodical changes in the sequence of subjects in the shelving of books in the stack room in relation to saving of the time of readers.

Sampling in the

1 Estimation of opinion of readers about library service received by them;

2 Estimation of library use; and

3 Accuracy in cataloguing work.

4 NEED FOR CHANGE OF WORK STANDARD

With a view to emphasising the need for changing a work standard for cataloguing with the changes in the context, the DRTC trainees (1969-70) collected data on certain cataloguing features, in about a thousand books, published during the period 1899-1968. The data for the period 1925-1968 were analysed. Using Graphs and the techniques of Least Square and Analysis of Variance, it is shown that the incidence of (1) Single Personal Authorship is decreasing with time; and (2) Two Joint Personal Authorship, Corporate Authorship, Collaborator, and Series is increasing with time, significantly so in the Natural Sciences. There is a predictable trend in the increase in the number of books presenting complexities in cataloguing. It is suggested that standards for cataloguing work formulated in the past will have to be modified in the light of the above findings. It is further suggested that to maintain earlier performance standards, some aspects of the method of cataloguing may have to be changed, or additional hands will have to be utilised in cataloguing work (1).

5 INCIDENCE OF FACETS

Gopinath and Jayarajan (2) have collected, analysed, and presented data on the incidence of different kinds of facets in compound subjects going with the Main Subject Medicine, in documents published during 1925, 1951, and 1967. Inferences are made about the

1 Mode of incidence of facets,

2 Percentage of subjects with different number of facets,

3 Pattern of combination among the facets in Compound Subjects, and

4 Trend of each of these attributes with time.

It is inferred from the study that on an average, there are more number of books with great intension in the later years.

6 PATTERN OF INCIDENCE OF SHORT-RANGE QUESTIONS

G S Raghavendra Rao (5) has collected and analysed, data about 773 short-range reference questions answered in an academic-cum-research type specialist library. The analysis of data gives information pertaining to

1 Percentage of the kinds of question in relation to the different categories of readers;

2 Time spent on the different category of questions; and

3 Time spent on questions put by different category of readers.

The patterns of incidence of the questions as found from the analysis of data are commented upon.

The subject-wise distribution of the short-range questions is compared with the subject-wise distribution of the

1 Library's holdings;

2 Books and periodicals issued to readers; and

3 Staff, students, and research scholars of the institution constituting the potential users of the library.

It is inferred that the Physical Sciences are dominant in each of these cases.

7 ANALYSIS OF CITATIONS

A K Gupta (5) analysed the citations given in the Indian journal of pure and applied physics V5 (1967), with a view to compiling a list of the most cited periodicals. These periodicals have been examined with respect to their

1 Country of origin;

2 Subject coverage; and

3 Age of citation.

Data on 'self citation', and 'repeated citation' are also presented, and the probable reasons for these two kinds of citations are given.

8 DUPLICATION OF DISCOVERY

Scientific discoveries constitute one source of ideas. The kind of ideas added, the mode and rate of their addition, the extent of duplication and the process of assimilation of ideas affect the growth of the universe of subjects. In turn, the growth of the universe of subjects affects the work of the librarian. As a case study, Neelameghan, Buche, and Gupta (4) present data on the discovery and duplication of antibiotics. Regression Analysis, Analysis of Variance, and a Modified Poisson Distribution are used to analyse the data and study the trend of duplication, the distribution of duplication, and the relationship between duplication and discovery. The findings are: (1) The total number of discoveries, new discoveries, and duplications are predictable by assuming a linear relationship between the respective pairs of variables; (2) The pattern of duplication is not due to chance alone; there is a regularity, in the statistical sense, in its behaviour; (3) The reported discoveries and duplications both increase with time; (4) The behaviour of the functional relationship between the number of discoveries in relation to time, and the number of duplications in relation to time, are different; (5) Over the thirty-year period 1937-66, the rate of duplication has nearly halved; and (6) There appears to be a tendency for the cumulative duplication to stabilise at about twenty-five percent of the cumulative discoveries, over the sixty-year period 1907-66.

91 BIBLIOGRAPHICAL REFERENCES

1 Sec 4 AHUJA (R), AMGA (H L), DEVADASON (F J), REVANNASIDDAPPA (H C), SINHA (M P), and GUNDURAO (D). Laws of library science and the need for change in work standards. (Annual seminar, (DRTC). 7;1969; Paper DB).

2 Sec 5 GOPINATH (M A) and JAYARAJAN (P). Analysis of subjects: A case study. (Annual seminar, (DRTC). 7;1969; Paper EA).

3 Sec 7 GUPTA (A K). Characteristics of documents cited by Indian physicists: A case study. (Annual seminar, (DRTC). 7;1969; Paper JB).

4 Sec 8 NEELAMEGHAN (A), BUCHE (V V) and GUPTA (B S S). Universe of subjects and duplication of discovery: A case study using statistical methods. (Annual seminar, (DRTC). 7;1969; Paper JC).

5 Sec 6 RAGHAVENDRA RAO (G S). Short-range reference questions in a specialist library. (Annual seminar, (DRTC). 7;1969; Paper HA).

6 Sec 2 RANGANATHAN (S R). Librametry and its scope. (Annual seminar, (DRTC). 7;1969; Paper DA).

32 PROJECT 2

Project 2, to be completed within six months after the formal course in DRTC, consists of the preparation of a Trend Report on an approved specific subject based on the survey of the current documents on the subject appearing in various periodicals, reports, etc.

4 DURATION

The formal course commences on 15 April every year and continues till about 14 June the following year.

5 ADMISSION

A candidate seeking admission to the course should ordinarily possess any one of the following minimum basic academic qualifications :

1 Post-graduate Degree or Diploma in Library Science.

Or

2 MA/M Sc or an equivalent degree or a degree in Engineering, Technology, Agriculture, Animal Husbandry, or Medicine, and practical experience in Documentation.

Admission to the course is strictly based on the merit of a candidate as judged by his academic record, and if necessary, performance in a special admission test held for the purpose or a personal interview by a selection committee.

6 AWARDS FOR PROFESSIONAL ATTAINMENTS

1 Associateship in Documentation on the basis of examination and the report of professional work in DRTC; (The Associateship is declared equivalent to the M Lib Sc degree by the Government of India).

2 Associate Fellowship in Documentation on the basis of report/thesis of research work done in DRTC ;

3 Fellowship in Documentation for outstanding contributions and published works in the field of documentation.

7 RESEARCH FELLOWSHIP

Some research fellowships are available to pursue advanced work in DRTC. There is also provision for research fellows to work with Dr S R Ranganathan, National Research Professor in Library Science, and Hon Professor, DRTC.

A practising documentalist will be provided fecilities to reside in DRTC for a specific period to pursue a specific line of research in the field of documentation.

8 PUBLICATIONS

1 *Library science with a slant to documentation*, a quarterly published in collaboration with the Sarada Ranganathan Endowment for Library Science; and

2 Proceedings of the DRTC Seminars.